Systematic Application of Psychology to Education

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To

Laura and Henry Carpenter,

who furnished always
the proper perspective—

and to

Mary and Bill Haddan,

who educated far better
than they knew.

Preface

Most books begin with some kind of an apology, explicit or implied, so that the authors may have the first word in their own defense. The tack usually includes some statement of the frame of reference within which the writers operate, as though this automatically excuses them in case of criticism. If the approach seems too subjective, the excuse is that an objective one would unduly restrict. If it seems too objective, hence lacking human touches, the excuse is that in an age of science, objectivity is at a premium. Our defense is only that, while we have tried to present a systematic treatment of the teaching-learning situation, we are also aware of certain predilections which color our anchor-points.

In the behavioral sciences, final truths are notable by their absence. Because of this, certain assumptions form points of departure. While we hesitate to call these "basic" assumptions, a statement of the beliefs will help in clarifying the development of our positions. One assumption is that change is inherent in all education. A second is that traditional

methods of coping with change are no longer adequate—status research is being supplemented with power research. As technological materials develop at a more rapid rate than ever before, a need for a technology of human learning becomes increasingly evident. The educational psychologist is likely to become a psychologist–engineer. Not only must there be improved articulation between the realms of the educational psychologist and the experimenter, but the educational psychologist must be willing to include "follow-up" in his area of responsibility. He must become truly practical, in that his recommendations must be worthy of the classroom test.

The teacher, even in an age of progressive education, is an extremely important controlling factor. If humanity is not to become victimized by the products of science, humans must utilize these products intelligently. The teacher must be able to aid his pupils not only in becoming happier social beings, but also in coping with an age of science. Merely developing psychological strengths to endure, to maintain stability, begs the question. There must grow a technology of education which will permit teachers to place learning in the category of the technologically implemented.

While the debates may rage over just how far the teacher ought to be prepared as a professional educator, there is rather general agreement that today's demands are pressuring teachers to "prove up" as never before. No one would suggest that teaching is ever going to be easy. But it just makes good sense to make available to teachers a way of entering the profession with a confidence that they are conversant with an approach that will not make it necessary for them to rely only on precedent, trial and error, and their personalities. They should not be required to go over the same ground that their predecessors have trodden, unless

the "tried-and-true" have stood more than the test of time.

This book is based on the professional theme, that is, the idea that the teacher of the present and the future must be not only a technician, following recipes, but he must be equipped to discover his own communicating techniques. Merely to add more courses to the teacher-training curriculum seems a poor approach to professional qualification. Teacher preparation ought to include instruction and practice in what may be called a science of teaching. According to this viewpoint, the teacher will become not only a creator of learning environments, but a manager of educational media. This means that he will be manipulating observable variables, to enter more directly and systematically into the teacher-learner situation.

Under the suggested strategy, the teacher does not take refuge in the pupils' individual differences; he merely refuses to accept apparent limitations as actual ones until the most efficient means available for change have been tested. (We do not claim to have furnished the teacher with the most efficient tools; but we do say that he ought to have at his disposal a means to compare our suggestions with others.) The teacher, according to this approach, does not take refuge in the growth of creativity as a subterfuge for failure to teach subject matter. But creativity, little understood as it seems to be, may also be subjected to various criteria. The term should not become a vague catch-all.

While the book treats teaching machines as current aids to teaching, it is to be hoped that our discussion presents them in a sound perspective, and not as a panacea. Since the development of programs and machines have become an important phase of current trends in education, a discussion of their uses and limitations is considered necessary.

It is obvious that our greatest indebtedness in developing

the psychological portions of our effort is to Professor B. F. Skinner, Harvard University who has labored so long and effectively in creating a fruitful system of behavioral analysis. While our debt to Professor Skinner is inestimable, it should be clear that he is not responsible for our interpretations and departures, which were made at times more on the basis of convenience than on technical accuracy. All outstanding contributors such as Professor Skinner suffer the depressing surprise of being misunderstood by those with different histories, problems, and viewpoints. We hope that our inadvertent distortions can be tolerated within the intent of our aims.

Most books are probably initiated by some critical incident. In this respect we owe our gratitude to Harlan Koch, Dean Emeritus of The University of Michigan. Dean Koch several years ago posed the question that set the stage for our efforts. He asked, "What is the *substantial* knowledge in education, the knowledge that can be used by teachers with a high degree of confidence?" His question crystallized our quest and stimulated the entire work. We hope to have contributed toward an answer to Dean Koch's question.

In the fall of 1960, during an invitational meeting on the new media, sponsored by the American Association of Colleges for Teacher Education, Professor Edgar Dale of The Ohio State University was a leading contributor. In the meeting he presented the rudiments of our perspective that is developed in Part II of the book, and which we believe is a fundamental phase of the whole approach. We owe Professor Dale our gratitude for providing the basic idea which made the building of our educational viewpoint possible.

The almost-daily contact with William Clark Trow, Professor of Psychology and Education at the University of Michigan, provided the kind of support and encouragement

to our way of thinking that sustained our efforts to complete the work. Professor Trow's unusual flexihility and tolerance for new ideas are inspirational testimony to the fact that, although one may near the age of retirement, he can remain pliable and creative in both ideas and attitude.

From Arthur P. Coladarci, Professor of Psychology and Education at Stanford University, we borrowed the idea of the teacher as hypothesis-maker. His idea is one of the hasic thoughts of the hook; and it led to much of the reflection on the role of the teacher as we have perceived it, and to the treatment on classroom research.

And we wish to thank all our students of educational psychology who have plied us with challenges and disturhing questions which led to a critical inspection of the present status of the field.

We make no definite claim that the psychological statements which we bave selected are tried and proved. Indeed, current researcb suggests that some of our chosen principles may be somewhat doubtful. Yet, it is not the purpose of the authors to defend any set of learning principles as final. Rather, our intent is to describe an approach that is more systematic than found in existing texts. We helieve that other sets of learning principles could be suhstituted for the one we have described without negating the central thesis of the hook.

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CHAPTER 1

The Problem

MANY YEARS ago education was a luxury. Today the very life of civilization may depend upon how problems of education are handled. In these United States public education is weathering its severest storm. Sweeping changes in teacher training, in public school curricula, and in methods of instruction are demanded. Suggestions for reform are legion —and, of course, as diverse as the philosophies underlying them. Yet, a common element can be discerned in the multitude of criticisms, attacks, and counterattacks that have emerged in the postwar era. The urgent need for greater efficiency in teaching has been a matter of concern to nearly all commentators. Improved efficiency is necessary, if for no other reason, because of the increasing complexity of the knowledge and skills required for survival itself.

Inefficient teaching methods are particularly disastrous at a time when society is in a state of rapid change. Technology is currently altering the quality of everyday life in

ways that could not have been foreseen even a few decades ago. With the gradual extension of automatic controls, some human skills are becoming obsolete almost overnight while new needs of production are created with equal speed. It would appear that we must be prepared not only for continuous change, but for the possibility of a constantly increasing rate of change.

Education cannot remain static under such conditions if it is to survive as a prime shaper of human destiny. What the current situation requires, above all else, is a comprehensive approach to the problem of maintaining efficiency in an ever-changing context. A new movement, based largely on the work of the "psychological engineer," has already begun to provide such an approach. It may prove in time to be one of the most significant developments in the history of education. While the spotlight has been focused on its more eye-catching aspects (for example, the teaching machine), the full scope of the movement has received little public attention.

The engineer-psychologist first came into prominence in the armed forces, where his job was to reduce hazards in military training and to minimize the time required for teaching special skills. In the postwar period he expanded his range of interest and was instrumental in developing the broader field known as "human engineering." With the coming of Sputnik I and the arrival of the teaching machine, the engineer-psychologist has moved into the purview of researchers in education. He promises to have a marked influence on education because of the kinds of problems he selects and the way he goes about solving them. The problems with which he is concerned can be aptly described as "power problems" because their aim is to determine how a given

situation can be *manipulated* or *controlled* to produce a desired result.

Until recently, the typical effort in educational research has not been so much to increase efficiency in teaching and learning as to delineate the features of the learner which facilitate or retard learning. Traditional research in education can therefore be termed "status" research; its purpose is primarily to *describe*. "Status research" can be thought of as a kind of map making; the aim is to chart an area so that its parts can be located and related within the map structure. (The map, which can function as a theory, does not have to be true in any absolute sense but merely serviceable as a tool.) Power research, on the other hand, is never merely descriptive. While it generally begins with a theory (or map), it is primarily concerned with putting the theory to use in the solution of concrete problems. Hence, power research can be viewed as a logical extension of theory and can be used to test predictions deduced from the theory.

It is appropriate to call the field developed by the engineer-psychologist "the technology of human learning." As the new technology grows, there is a danger that the educational psychologist may increasingly assume the role of spectator rather than that of active producer. A most embarrassing result to educationists could be the discovery that the real experts on teaching and learning may arise from the ranks of learning technologists who have never enrolled in a single course in methods of teaching. Such a discovery might very well place limitations on some teacher training institutions as they are now organized.

Two noticeable weaknesses can be discerned in the technology of learning as it relates to teaching: (a) the lack of a comprehensive viewpoint on education to guide efforts in

the new technology, and (h) insufficient knowledge of the nature of human learning as it pertains to school instruction. The educational psychologist can help to fill both gaps, first hy developing a theory of teaching which can he used to guide research in the new technology, and secondly by leading the way to improved methods of applying psychology to the prohlems of education. A new research front could he opened up, hringing the teacher and edncational psychologist together for improving the effectiveness of instruction.

In education there are few special techniques of application comparahle to those in a field such as clinical psychology. Teachers rarely have sufficient training either in theories of psychology or in rigorous application to qualify them as professional persons. As Coladarci observes, professional behavior amounts to the application of theory toward the solution of practical prohlems. Clearly, education involves many practical prohlems of a psychological character.

In the years to come we must expect teaching to hecome increasingly prescrihed, planned, and organized rather than freewheeling and unplanned. The choice faced hy the teacher, therefore, is either to accept prepared prescriptions externally imposed or to gain sufficient professional skill to make his own prescriptions. If he follows the former course, he must remain content with a relatively minor role, forced upon him hy the expanding use of mechanical and electronic gadgets; in short, he will become a technician. If he chooses to become a professional prescriber and diagnostician of a learning situation, then he is likely to increase his strategic importance despite the growth of automation in education.

When difficulties arise in classroom learning, it is always tempting to lay excessive blame on the traits of the learner rather than on inefficient teaching. (There is much talk about individual differences, mostly for the purpose of classifying

students, rather than for understanding how conditions can be managed to bring about or diminish differential behavior and for determining which students are educable and to what degree.) The moral to be noted is simple: It is wise to exhaust the store of things we can do to solve a problem before we attribute failure to something beyond our control. The authors believe that American teachers tend to blame such things as low I.Q., poor motivation, abnormal glands, insecurity, anxiety, and the like, as ways of minimizing responsibility toward educating the child.

The kind of status research that now prevails in education has highlighted traits of the student, as interpreted by scores on intelligence tests, aptitude tests, personality, interest, and achievement measures. Such research has resulted in emphasizing the *limitations* of the teacher's influence on the student. Under these conditions, the teacher is probably justified in having a slightly negative attitude toward research because much of it does not help him in performing primary tasks, concerned with doing those things that will help pupils reach goals more efficiently than is possible without the teacher's help.

The teacher is obviously dealing with a power problem; he wants to learn *how* he can improve his aid to the pupil. Any lack of such information in the annals of educational research may place the teacher largely under the control of tradition and quasi-scientific practices. An obvious need is for a sound method of applying the knowledge of related fields, such as psychology, to teaching.

It is sometimes said that teaching will never become scientific *because human learning is too complex, too dynamic,* too difficult to measure and control to come under scientific scrutiny. To support this claim it would be necessary to have a representative sample of all possible research methods and

to demonstrate their inappropriateness to human learning. Since no such demonstration has been even remotely approximated, it is not reasonable to accept the argument that teaching cannot be scientific.

Those who have created and nurtured educational psychology have described the facts of human development, pointed up the generalizations in learning theories, discussed the importance of mental hygiene, identified the features of tests and measurements, given findings of group process studies, covered the psychology of motivation, and sprinkled the whole with short case histories, anecdotes, and homey illustrations. But less effort has been exerted in trying to develop a most essential function of any applied area—a *system* for putting the knowledge to work, a system that can be used efficiently by teachers in daily practice.

Most textbooks do not contain much direct information on methods of application. It is generally assumed that once the knowledge is provided, a sizable transfer will be made into classroom teaching. A second possible assumption is that courses in teaching methods and practice teaching are largely given for helping students get a taste of reality, which really means a taste of the *status quo*. Such sampling is quite useful but it does not necessarily provide the bridge of application between psychology and education. The simple fact is that such a bridge has not yet been built.

THE MEANING OF APPLICATION

The full meaning of the word *application* does not seem to have been well developed in the language of educational psychology. Vagueness in meaning seems logically related to the fact that techniques of application are yet to be de-

veloped. We sometimes hear statements similar to the following:

> "I have come to the conclusion that learning theories have no *application* value for the teacher."
>
> "Gestalt concepts are particularly *applicable* for understanding group dynamics."
>
> "Educational psychology has little *applied* value because it is too abstract."
>
> "Knowledge of tests and measurements ought to be the most *applicable* segment of educational psychology."

It seems clear that *application* should assume an important place in the technical vocabulary used in the field.

But to apply an idea is not the same as to apply a material tool. Just what happens when knowledge in one area is taken to another discipline and put to work toward the solution of practical problems? Careful consideration of the question will suggest that the above statements may have *little* relevance toward clarification of our term *application*.

The following illustration suggests how a general statement may be processed to help solve a practical problem. We know that it is more difficult to push a blunt, heavy wire through a piece of cloth than it is to push a sharp needle through it. Similarly, we know that snow shoes will allow us to walk over snow without sinking far into it. Total body weight is spread over a larger area of snow than when we are wearing ordinary shoes only. In the case of both the blunt wire and the snow shoes, pressure is distributed over a large area, producing less penetrating power, or pressure per unit area. In physics the general statement is condensed as: $P = \frac{F}{A}$, meaning that pressure equals total force (such as body weight) divided by the area (shoes) to which the force is applied.

Can this principle be transferred tn another practical situation? Suppose a skater has broken through thin ice and is unahle to climh hack ontn the surface. A nearhy stack of lumher contains long, broad boards, while another stack contains long, narrow boards. If we are thinking properly and do not let overwrought emotions control us, we can act in harmony with the general principle, above. For example, we may grah two long, wide boards and push them to the edge of the hreak and use a long, narrow one for pulling the skater into the wide ones.

Deriving an Operating Rule. How has the rescuer applied the pressure principle? He could have used it in a conscious and deliberate way hy "thinking out" the relationship between the principle and the concrete situation. On the other hand, he could have recalled a special rule he had learned before. His memorized rule might have been stated: "If you want to rescue someone who has fallen through thin ice, get wide, long boards, scoot them to the edge of the hole. Then take a pole and maneuver the victim to the boards and pull him from the water." Such a rule is an example of what we call an "operating rule."

Notice the difference between the two cases. In the first case, the person works *from* knowledge of the general principle *to* the operating rule; we say that he has made or created the operating rule from the general principle. In the second case, he has *remembered* the operating rule and used it directly. An operating rule, like a cookhook recipe, is very specific and can be put into practice only under certain conditions. The important point is that a general principle can be used to *create* a number of operating rules. Merely depending on the *recall* of operating rules alone may not suffice, especially when there are unusual conditions in the problem

situation. An operating rule is a narrow prescription that is useful only under particular circumstances.

It is better to learn how to diagnose complex situations so that a prescription can be made to fit the case than it is to depend only upon memorized rules. A teacher who goes "strictly by the book" will experience many frustrations because the actual situation is rarely just as the book indicates. The most economical and professional method of meeting problems of teaching is to use appropriate criteria for diagnosing the learning situation and deciding which tools should be used for prescribing an intended improvement.

There is one kind of situation, of course, in which the use of memorized rules is needed. It is the emergency situation, where an immediate physical danger is involved. In order to meet such exigencies it is best to get special training (drill in the use of operating rules applied or performed automatically, as in the case of fire drill). The majority of teaching problems, however, allow time for reflective thinking. Yet the teacher often is not equipped to make the appropriate analysis effectively.

As indicated earlier in the chapter, the average teacher can hardly be said to measure up to the criteria that define professional behavior, particularly as a professional psychologist. A typical teacher will take one undergraduate course in general psychology and one course in educational psychology. Both are overviews or surveys on the introductory level. The kind of specialization in psychology that one needs to insure professional competence is seldom found among educationists below the doctoral level. Those who do reach that level generally turn out to be specialists known as educational psychologists, school psychologists, or special counselors. Proper training, however, should be provided for

the average teacher so that he can build his own methods of instruction; *he should be the architect of methods rother than the blind follower of ready-mode techniques.* Yet, before the teacher can devise his own methods he needs to know how to examine psychological theories critically—to delve into basic principles, to understand their development, and to learn their scope and limits of application.

COOKBOOK VERSUS PROFESSIONAL MODES OF APPLICATION

We have seen that the term *application* can have meaning in two different sets of activities: (a) the "cookbook" or technician mode, in which operating rules are made by someone else, while the technician applies them without adequate understanding of how they were developed; (b) the "professional mode," or the creation of operating rules from knowledge taken from related disciplines. The most important difference between the two modes is in the "why knowledge" that supports the professional method.

The operating rule or "cookbook recipe" is the only kind of verbal knowledge that is applied directly to practical problems. To apply a verbal expression is to translate symbols into action in an appropriate context. "Pour one cup of sugar into a mixing bowl." These words are translated into action quite easily, and so we say that they allow for *direct* application.

But some verbal expressions cannot be directly applied because the expressed principles are abstractions, not represented completely by any real situation. We cannot see a situation that is represented by "pressure equals force divided by area." In order to apply the principle, we must first

derive an operating rule from it. In this particular case, the derived operating rule might assume the form of the following statement of specific directions: "Notice that a ping-pong ball is crushed when one adult steps on it. But place one hundred ping-pong balls on the floor, closely and uniformly spaced, and place over them a large piece of heavy plywood. Now notice that the same adult can step upon the plywood without crushing any of the ping-pong balls." *The professional person has the training that helps him to create operating rules from abstractions or general statements.*

Sources of Operating Rules. An operating rule may come from trial and error, from loose speculation, superstitution, tradition, or from wild hunches or intuition. On the other hand, it may be based on logically sound implications from facts and theories. An operating rule that is found in a well-developed discipline, and which is carefully derived from adequate knowledge, is more useful than a rule which is less soundly based. It becomes a link in a chain of knowledge between a field of inquiry and a practical enterprise. This link is the basis for fertilization between theory and practice.

PROCEDURE

This book is based on the theme that teachers should be able to create their own operating rules for teaching. The process of producing teacher-created operating rules should be rational, deliberate, and systematic. We shall call this idea the *professional theme* because the behavior guided by such a theme assumes the features described as professional in the preceding section.

The behavior of teachers and the content of texts in educational psychology suggest that the professional theme is

not always well implemented. When educational psychologists exchange serious thoughts on the value of current courses in educational psychology they include such points as the following:

a. Students do not seem to appreciate the importance of psychological theories to education.
b. Theories of learning seem to have little value for the teacher.
c. Bright students tend to rate course content as repetitious, platitudinous, nonsubstantial, and too obvious to be informative. Texts are too long and are inadequate as sources of professional guidance.
d. Relationships between education and psychology are not clearly established. While the two fields are obviously connected by overlapping interests, the specific links that would be most helpful to teachers are not well delineated.

A common element running throughout most items of criticism of educational psychology is the weak *application* value of the content. If the teacher fails to reach the point of demonstrating the value of psychological claims, then the criterion of application has not been fully reached.

The following phases point up the course of action followed by this book.

Phase I. Identify an educational problem within an educational perspective.
Phase II. Analyze the problem to determine the nature of its demands.
Phase III. Establish standards of application to agree with the demands of the problem.
Phase IV. Select those psychological concepts that logically meet the demands.
Phase V. Use the psychological concepts to build an ideal answer to the problem.
Phase VI. Use the ideal answer as a tool for analyzing educational activities which contain the problem.

Phase VII. Identify tentative operating rules as the results of problem analysis.
Phase VIII. Test the tentative operating rules in the educational setting.
Phase IX. Retain operating rules that survive the test.

Later chapters illustrate how the nine phases are developed. Let us now clarify the meaning of each phase.

Phase I. ***Identify an Educational Problem Within an Educational Perspective.*** When something is put to use there is always some task or problem to which it is applied. Application, therefore, bas its origin in a problem or a task. In our example, the wooden boards, per se, did not constitute application in the rescue attempt. The boards were instruments only because there existed a problem or task in which they could be used profitably. *Knowledge of only the formal fields of psychology without knowledge of the problems of education is insufficient for equipping us to apply psychology to teaching.* Hence the logical beginning in building a method of application of psychology to education lies in the problems of education.

A problem or task finds its meaning in the larger context of which it is a part. Suppose we are given the following statement: "The task here is to tighten spring *c* by turning key No. 3 to the right until a clicking sound is heard." We know the meaning of every word in this statement. Yet since there is no indication of the context, we do not grasp much of the statement's significance. The situation could be the occasion for winding a toy, for winding a clock, or for preparing a detonating device. The meaning of the specific problem increases as the perspective of the situation broadens.

What does it mean to provide context for an educational problem? It requires a point of view or perspective on some

significant phase of education. The viewpoint should include certain values aod aims and should indicate some direction that the learner should follow. A significant slice of philosophy is needed in order to provide a context which will enlarge the meaning.

Phase II. *Analyze the Problem to Determine the Nature of its Demands.* The prohlem determines the kinds of tools which will he needed for a successful solution. This general rule can be easily illustrated. If the problem is to find out what is wrong in a radio and to repair it, then a certain set of tools is more appropriate than another set. If the task is to make three typed copies of a letter, then different tools are appropriate. *A tool is appropriate if its features have the specifications required by the task.*

Diagnosing a teaching situation is often difficult because the teachiog prohlem is complex, dynamic, and coneerned with interaction of many variahles. It is of the utmost importaoce to grasp the demands of the educational prohlem before we try to apply psychological tools. This phase is often neglected by those who would use psychology in teaching.

Phase III. *Establish Standards of Application to Agree with the Demands of the Problem.* When the problem is analyzed, the demaods or requirements which tools must meet before they can be considered appropriate should become fairly clear. We can treat those demands in such a way as to make them into standards of application.

Suppose the task is to carve a set of chessmen from some chunks of ivory. The carving tools must be of a certain hardness, sharpness, and limited range of size. These statements of requirements are the standards or criteria which must be met by the tools before they can be successfully applied.

Phase IV. *Select those Psychological Concepts that Logically Meet the Demands.* If a set of demands or require-

ments can be clearly specified as a result of analysis of the problem, then those requirements should be useful in selecting promising tools from psychology. The fact that psychological concepts have different properties suggests that they serve different functions. It is both desirable and reasonable to try to determine which functions can be expected of a set of concepts. We may note those successful uses they have served in the past and examine them for other properties.

Phase V. *Use the Psychological Concepts to Build an Ideal Answer to the Problem.* Once a kit of tools has been chosen, the obvious thing to do is to put them to work. Concepts chosen should function as a point of view about behavior, or they should at least provide a means for stating the practical problem in terms of a psychological meaning. *It must make sense when the technical words borrowed from psychology are used to express the problem.*

But we must go further than to just assign the concepts in a meaningful way within the educational setting. We must attempt to use the borrowed psychology in such a way that an ideal answer to the practical problem is derived. If the psychological tools or concepts are inappropriate, then the attempt will be cumbersome and nonfunctional. If the psychology suggests a logical answer then the standards chosen in Phase IV gain in application value. (The "ideal solution" is only a tentative candidate for an adequate solution; it must be put to the test.)

Phase VI. *Use the Ideal Answer as a Tool for Analyzing Educational Functions which Contain the Problem.* This is the critical phase. We may now compare actual situations with the ideal answer or temporary model. Differences noted between the actual situation and the ideal or model provide a basis for making operating rules. We use the model to analyze current teaching practices and then locate changes

which can reduce differences between model and problem. It is a necessary condition that the suggested changes can be tried in the practical setting; the tentative operating rules must be *applied*.

Phase VII. *Identify the Tentative Operating Rules as the Result of Analysis in Preceding Phases.* The only new aspect added in this stage is an ordering of the operating rules so that they may be conveniently tested. When the model has been used as in Phase VI to analyze the actual situation, then the operating rules will have been formulated in the language of psychology. As a result, the testing phase is brought into the realm of the teacher's activities.

Phase VIII. *Test the Tentative Operating Rules in the Educational Setting.* One purpose of our approach is to develop operating rules that can be *tested* by the teacher. We further expect to describe a process by which the teacher can *demonstrate* valid implications from psychology. When the teacher can analyze a teaching problem, select appropriate tools from other fields, and use those tools to develop tentative operating rules to be tested in teaching situations, he will have arrived at a genuine professional level.

Phase IX. *Retain Operating Rules that Survive the Test.* When nearly all the teachers who test a given operating rule find it to be supported by test evidence, the rule should then become a relatively permanent part of the guiding principles in teaching. "Relatively permanent" is indicated because no one can guarantee just how stable a rule will be throughout the many changes that take place over a period of time. All operating rules are tentative, but those surviving tests in a variety of conditions will be the more permanent ones.

Among the more important advantages of a *systematic* process of application are the following:

a. The professional competence of the teacher will probably rise because the approach should help him to translate theory into practice. Theory should therefore become an accepted basis for decision making.

b. At present, much of educational psychology suffers from a lack of substantial knowledge that can reliably support certain ways of managing learning. This may be due to a lack of ready means of translating knowledge of psychology into operating rules. It is hoped that the approach described here will help in determining more substantial knowledge which has application value.

c. A systematic method of application should promote development of educational theories. While education depends upon other disciplines in certain ways, it contains enough that is unique to merit its own theories. Although theories of education already exist, there seems to be a lack of ferment in defining the role of the teacher, in clarification of teaching functions, and in fixing the proper place of control in effective teaching.

A concerned and perhaps even an anxious awakening seems to be needed to stimulate action for the wise management of the products of technology as related to education. One danger in the rapidly growing teaching machine movement is that it may never develop beyond a few narrow techniques which may be widely adopted without regard to ethical and psychological consequences. The behavioral engineer may suddenly loom on the horizon as the logical person to "take over" teaching because of his development of means to increase learning efficiency. Value orientations and goal perspectives must come to the fore to place technological developments in proper relation to other aspects of educa-

tion. It is possible that the dormant status of some phases of education may encourage the adoption of radical changes without awareness of dangerous consequences.

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CHAPTER 2

Analysis of a Teaching Problem in an Educational Perspective

THE ROAD to making useful operating rules begins with a practical problem. Trying to apply principles of psychology to teaching without first locating a teaching problem is like trying to apply paint to an imaginary house. The first step, therefore, is to locate a specific question or difficulty. One important question in education can be stated as follows: *How can the teacher help students acquire subject matter efficiently?* Not only do teachers accept the question as an important problem, but it is also the basis of much current criticism of education. The charge of a lack of progress in the efficiency of teaching has gained such intensity that educators have been forced to recognize the problem with grave concern. Whether or not the charge is valid cannot be determined by verbal rebuttals, but only through exhaustive research efforts.

An Educational Perspective. After a problem has been chosen, the next step is that of providing sufficient context for viewing the problem in a meaningful perspective. The context will be only partly developed here because it will be expanded in greater detail in Part II of the book as a prelude for the analyses of teaching practices.

Let us consider the purpose of teaching content as having four phases:

a. *Acquiring information* is that stage in which the learner comes in contact with the new facts, terms, principles, and theories in the subject matter. Unless the pupil succeeds in acquiring the necessary information, he cannot be expected to manipulate it critically and creatively, nor even to use it effectively in practical situations.

b. *Using the information* is the stage of putting the information to work toward solving problems that exist outside the subject matter itself. Most viewpoints on education accept the view that the learning of subject matter should have some value for meeting problems in everyday living. While there are differences of opinion as to the degree to which school learning should meet the standard of practical utility, virtually all thinkers on education agree that information holds a significance that extends beyond the mere acquiring of it.

c. *Analyzing the content critically* is a valuable phase for deepening the learner's understanding. Skill in making searching analyses provides the pupil with a measure of self-confidence because it places him in a more commanding role in relation to the subject matter than does mere acquisition of information. Fruitful analysis requires a skill that seems to bring its own reward by revealing considerations of content that previously were not apparent. Somehow the act of finding imperfections in a topic seems not only to help bolster

the learner's self-confidence, but to stimulate attempts to improve that which is being analyzed. Thus, important functions of analysis are clarifying the nature and significance of a subject matter and preparing the way for posing new and searching questions.

d. *Manipulating the content creatively* is a goal phase that has perhaps given the learner his greatest feeling of satisfaction. Our perspective of content learning asserts that movement toward creativity should be stimulated as early as possible so that the learner can experience the most intense reward available in the educative process. Early satisfaction in creativity is believed to be the kind of stimulation that will sustain the growth of learning throughout the productive life of the person. Not all learners produce high-level creations, but it is believed that all learners can develop the kind of behavior that predisposes them to create, with consequent satisfaction and sustained learning effort.

Our perspective indicates that the teacher's problem, *as limited by our definition,* is contained largely in the first phase of learning—acquiring information. The problem occupies only the initial corner of education in subject matter, but it should suffice to help in illustrating an approach to the application of psychology to teaching.

Analysis of the Teacher's Problem. The purpose of this analysis is to show which kinds of psychological tools would be most promising for use in dealing with the problem. Some tools (concepts) in psychology are more useful than others for attacking the chosen group of teaching difficulties. A careful inspection of the problem should help in selecting the more promising concepts. The point of all this reduces to an axiom which provides an important support for our effort: *The appropriateness of any tool is determined by the needs found in the problem to be solved.* If the problem is to

change a tire, then only tools with certain qualities can be used effectively. Analysis of such a problem is quite simple and easy, for the needs are readily discovered. Likewise, analysis of the teaching problem is undertaken in order to determine which needs are to be satisfied.

Of what value is the analysis of the chosen teaching problem? Instead of trying to answer in the abstract, we shall proceed to examine the problem and to identify the kind of decisions that can be facilitated by analysis.

Analysis of the Problem. There are three phases involved: defining key terms; identifying the assumptions on which the problem rests; identifying the facts central to the problem. A final task will be to tie the definitions, assumptions and facts together to describe the kind and form of psychological knowledge which seems to be needed to develop useful operating rules.

Defining the key terms. Let us first repeat the statement of the problem and underline the terms in that statement which seem to warrant special treatment. "How can the teacher *help the pupil acquire subject matter efficiently?*" Special definitions are in order when processes such as analysis, measurement, and evaluation are involved. Let us proceed with the key terms in our problem.

Acquire. The meaning of this term is rooted in both a process and an outcome of education. As a process "acquire" refers to the presentation of course content plus the reactions of the learner leading to a demonstration of proof that learning has occurred. There are two common standards used to measure acquisition. They consist of tests of *recall* and *recognition.* Recall tests require the learner to supply a sample of material to which he has been exposed. A recognition test requires the learner to identify one or more correct answers embedded in a set of answers furnished by the test item.

Correctness is the degree of correspondence between responses or answers chosen by the learner and those listed in a key as most appropriate.

Efficient. This term is concerned with the teacher's effect on the pupil in the acquisition process. The teacher influences efficiency when the things that he injects into the acquisition process save time and effort for the student in reaching the goals of recognition and recall.

Help. To help a pupil is to stimulate him to behave in a way that represents desirable educational outcomes without negative effects on attitude and motivation.

The terms *pupil* and *teacher* need no special definition in the present analysis.

Important Assumptions. Every query rests on certain assumptions. If an assumption is false then the intent of the question is not compatible with the facts. Our teaching problem rests on two assumptions:

a. The first assumption is that the teacher can do something to help students acquire subject matter. Such an assumption is important because, for one thing, it is used in hiring teachers. If the assumption is false, then it would be appropriate to redefine the things that teachers are expected to do. One of the most significant tasks facing education today is the clarification of the teacher's role. We shall have some suggestions concerning role clarification in a later chapter.

b. A second assumption, which follows from the first, is that how the teacher behaves makes a difference in the pupil's learning efficiency. If this is true, then some things that the teacher does may lead to positive results, while other forms of action may bring negative or neutral outcomes. "Positive" and "negative" refer to the kinds of changes in behavior actually occurring in the pupil as compared with

changes which the teacher has tried to help the pupil establish. A "positive" change is movement toward a goal, while a "negative" change arises from strengthening of behavior that is incompatible with the educational aim.

c. Facts. A worthwhile analysis of any practical problem must emphasize certain facts. Only from the study of important facts can a clear view of the nature of the problem be seen. The demands of the problem should determine the useful properties of the psychological tools.

The aim of the teacher is to help the pupil change his behavior along certain lines. It is not enough to identify behavioral change as the goal. We must be more specific and locate the kinds of change that teachers try to promote. These changes may be classed as follows:

a. *Helping the pupil acquire new ways of behaving.* Some of the ways used by teachers to bring about new ways of behaving can be identified in everyday language. They explain, demonstrate, provide hints, encourage the pupil to try, verbally approve correct performance, assign homework, and the like. Each of these things is often done in the hope that acquiring new behavior will be facilitated.

b. *Helping the pupil strengthen behavior which he already shows but expresses in a precarious or weak way.* When the teacher helps pupils to build skills in reading, writing, computation, and spelling, he is achieving the present goal. While the teacher explains, demonstrates, encourages, gives hints and in other ways seeks to improve skills as well as to increase acquisition, there is a special class of additional things that teachers do for skill building. They provide conditions for practice and inform the pupil how he can alter specific acts or movements or symbolic responses to increase his skill. Teachers give the learner information that is usually detailed and is often accompanied by suggestions to the

pupil as to how he can judge his own performance and alter it accordingly. The aim of skill building is efficient performance.

c. *Helping the learner weaken undesirable behavior.* While this is a part of skill improvement, it deserves special mention because it can be a desirable goal without involving skill. The teacher tries to discourage, for example, immature and inappropriate habits which annoy others and which inhibit efficient learning. Inappropriate techniques, however, are often selected by the teacher. The common practices include mild disapproval, calling attention to the negative side of the habits, shaming, warnings, and reprimands.

d. *Helping the pupil to increase his self-control.* The intent is to help the child act in an approved way without his being directed or commanded. Many teachers do not seem to have special methods to promote this goal other than exhortation, reminders, and warnings. They harbor a vague hope that with the getting of more knowledge and academic skills, the pupil will somehow succeed in acquiring self-control. Often, much of this hope is invested in growth of socialization as a road to self-control.

We have selected the above as aspects of the teacher's intent. Let us now try to draw together the facts under a single concept. We have noted before that the teacher's efforts are indicated by such terms as *explains, demonstrates, describes, requests,* and *suggests.* These actions are attempts to *influence* pupils to change certain behaviors. Since the aim of teaching is to help the pupil through acquisition, strengthening, weakening, and self-control, "teacher influence" has meaning in both intent and outcome.

A formal definition of "teacher influence" should help us move toward a clearer understanding of its connection with psychological terms. "Teacher's influence" is defined as *a*

deliberate attempt to manage stimuli so that the learner alters his behavior in some desired way. It should be clear that the meaning of "teacher's influence" is rooted in the facts of teaching, in the things teachers try to accomplish, and in the ways adopted to realize goals. The following features of useful tools for getting at our problem are worth identifying specifically.

PROPERTIES OF TEACHER'S INFLUENCE

Observable Operations. The things that teachers do to influence students should be observable. When a stimulus is observable it has an effect on some sense organ such as the eye, ear, nose, and skin. Things that teachers do which influence must have some effect on the senses of the students, else they do not qualify as effective stimuli.

Deliberate Manipulation. Some actions of the teacher are not under his conscious control. An example of such an action would be a facial tic. We may say that a tic is not something that a teacher *deliberately* uses to influence the student. We rule out unconscious actions on the part of the teacher from the meaning of "teacher's influence" because the main interest here is toward *controlled* application of psychology. Those positive effects of teaching that are beyond the conscious control of the teacher furnish an index of the nonprofessional activity of the teacher. There are those who believe that the teacher's influence is entirely a matter of nondeliberate, unconscious, and uncontrolled behavior by the teacher. Does it follow then that rational, articulate, and controlled attempts to influence pupils are a waste of time? Another claim is that teachers should be selected mostly on the basis of their personality traits. Our claim is that effective

teaching is largely a product of deliberate, rational, and systematic decision making.

"Deliberate manipulation" also points up the fact that teachers also consciously control *things* to influence the pupil. For example, a textbook can be manipulated or controlled in a variety of ways by the teacher. He may use it to stimulate careful reading, for critical analysis, and for dealing with practical problems. Or he may be so noncommittal on how to use the book that most pupils may fail to read it. *We believe that some influences of the teacher which are presently "unconscious" can come under deliberate control as the means for effective application are identified.* It is conceivable, for example, that new techniques in the management of textbooks—techniques that some teachers may now be using, but with only a dim awareness of important controls involved—may greatly increase their stimulus value for efficient learning.

Teaching functions are embodied in ways of stimulating the learner. We have noted that the stimuli in teaching should be observable and manipulable. It is important to show why the psychological tools must represent observable and manipulable things in the teacher's environment. The next section is intended to make this clear.

Why Some Principles Work and Others Do Not. When we put psychology to use in teaching, we are dealing with verbal expressions. We have seen earlier that a word cannot be directly applied like a material tool such as a screwdriver, hammer, or saw. A verbal expression however, can stimulate a person to act out something that the words represent or to make some overt reply. It is such a form of application that we are concerned with in building the bridge of application between psychology and education.

A principle is a statement that is supposed to describe a

relationship between two or more things that exist in nature. It is supposed to identify some uniformity. Sometimes one or more of the key terms may represent only presumed or hypothetical things, that is, they may not be seen directly, but only inferred. A good example in psychology of something inferred is "motivation." We do not see motivation. We infer it from the way one behaves. It follows that motivation is not *directly* manipulated by the teacher in a fashion similar to the manipulation of chalk, erasers, books, maps, verbal symbols (words), and the like. Motivation is the *result* of influence brought about by manipulation of stimuli rather than by manipulating the motivation itself directly. To apply principles of motivation in teaching means to arrange conditions so that students want to act differently. The practical significance of the problem of motivation lies in *how* the teacher can influence the student so that he behaves in a way that reflects a desire to learn. All "how" problems are resolved by manipulation of things in ways effectively suiting the aim.

Let us examine some typical statements that are sometimes presented as principles in educational psychology.

a. All learning is motivated.
b. Purpose serves to unify experiences in learning.
c. A response becomes progressively less likely to occur as it is repeated without reward.

Can we determine why some principles are serviceable in solving problems and other principles fail to be useful? The quest should lead us to locate properties shared by useful principles (as well as those features which contribute nothing toward application). Let us again look at the three principles stated above.

"All learning is motivated." In what way can this statement be put to work by the teacher? What features does it have that either make it applicable or prevent it from being useful? The two questions should be answered in relation to the "teacher's problem" as we have defined it. We have shown two central features of the problem: observable operations and deliberate manipulation. Now let us identify some specific rules that can be used to help us decide on the usefulness of the principle which we are examining.

Teacher influence is found in those actions of the teacher that *stimulate* the pupil. Our first rule, therefore, can be stated: *The applicable principle should indicate or imply a form of stimulation.* The principle "all learning is motivated" can be interpreted to mean that all learning is stimulated, making the terms *motivated* and *stimulated* interchangeable. An examination of motivation, however, reveals several different reference points. Some psychologists use "motivation" to refer to a physiological state such as hunger. Others use a mentalistic reference point, meaning that a motive is some conscious intent. Many psychologists, however, say that most motives are unconscious and arise from a psychic energy which causes behavior but which can never be observed itself. Still other psychologists view motives as referring to environmental influences and therefore see the management of external stimuli as ways of motivating.

The fact that the status of "motivation" in psychology lacks clarity and a standard meaning makes its application in teaching difficult unless it is borrowed from a psychology that restricts the meaning of the term. A difficulty, however, in the notion that all learning is motivated is that it is not a principle for action but a kind of definition. It says that whatever learning may be it cannot exist without being motivated.

The real function of the principle should be to classify events called "learning" under a class of the "motivated." But since the principle does not do this, does not suggest a particular form of motivation, then it does not seem relevant to our first rule.

Our second rule is that *the stimulus operations must be observable*. Since there are no stimulus operations that seem to be implied by the principle which we are analyzing, the second rule cannot be satisfied by the principle "all learning is motivated."

The Stimulus Operations Should Be Manipulable. This third rule is not satisfied by the principle we are examining because no stimulus operations can be deduced.

We conclude that the principle "all learning is motivated," taken as an isolated statement, has little application value for the teacher when it comes to dealing with our chosen problem (what the teacher can do to influence behavioral changes in pupils). It does little good to emphasize the principle that all learning is motivated because there is nothing in it that provides a handle and fulcrum for application. The handle which is called for by the selected teacher's problem is something that can be manipulated which can serve to stimulate. The fulcrum is the point or place of stimulus contact. Roughly, our rules of application may be represented by the lever as a simple machine.

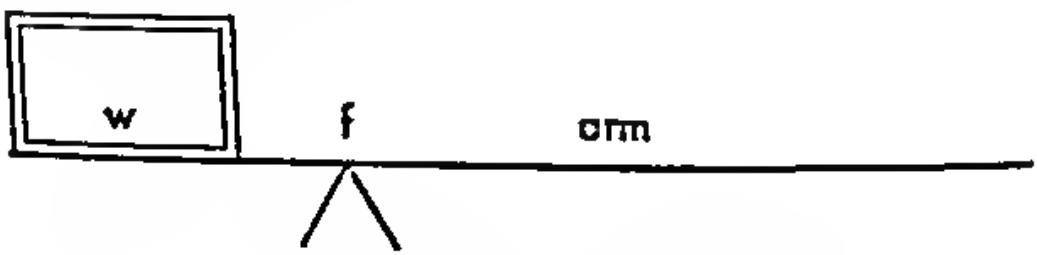

FIGURE 1. Weight is moved (influenced) by manipulation of arm. ("f" is the fulcrum)

Figure 1 is a crude model to illustrate the meaning of application of a concept to a problem which requires the manipulation of something in the environment to change the behavior of the student. "All learning is motivated" has no handle or stimulus for the teacher to grasp as a means for inducing a desired change. (Technically speaking, when a principle has no handle that can be controlled it has no manipulable independent variable.)

Let us inspect briefly the second principle, "purpose serves to unify experiences in the learning situation." Does this have a handle? Yes, the intended handle is indicated by the word "purpose" because it is the thing that is supposed to bring about a change ("the unification of experiences").

Can this handle be manipulated by the teacher? The answer is "no," because there seems to be no direct way of manipulating purpose. Apparently "purpose" in the principle refers to the purpose of the learner. The teacher cannot manipulate purpose as a stimulus object. He may do things, however, to influence the student's purpose. This principle has little power for the teacher because there happens to be no handle at all, but rather, something that is influenced by other unspecified handles. Principles that use purpose as causes for behavior *seem* to be supplying something useful, but upon close inspection they turn out to be truisms or platitudes, in many cases. Many people probably accept them, but they provide no power for bringing about desired changes.

Now, let us analyze the third principle: "A response becomes progressively less likely to occur as it is repeated without being rewarded." Where is the handle here? We find it by noting which term in the principle refers to the apparent cause of something. We see that the result of the cause is "a response becomes progressively less likely to occur." It is

clear that when a response becomes less likely to be made by a given pupil then some change in behavior is indicated. What is supposed to be responsible for the change? We find the handle located in the latter part of the principle (although the causal term may be found in any part). The handle is "without being rewarded," which is presented as the something which brings about decreased chance of the response. Can rewards be manipulated by teachers? Certainly, some kinds of reward can be controlled, such as words of approval, commendation, granting special privileges, and the like. While the stated principle does not specify the reward that is to be controlled, it does indicate the *effect* of withholding reward, that is, a lessening of the chance that the response will occur. The principle, then, seems to have definite power for indicating how the teacher can deal with the problem of weakening undesirable behavior. It is clear that rewards which are controlled by the teacher can be withheld as well as presented.

THE DIFFERENT KINDS OF PRINCIPLES FOUND IN EDUCATIONAL PSYCHOLOGY

Statements presented as principles in educational psychology seem to conform to no single pattern. They can be classified in several ways. We shall sort them according to the ways in which they seem to function. It has not been established that principles *ought* to have all the functions indicated. Let us merely identify the different statements that are currently being treated as principles.

Principles that Function as Definitions. A definition is a statement that is intended to provide a clear meaning of a word or term. Meanings, however, are determined in an

arbitrary fashion and resolve themselves into *decisions* on how a term is to be used. In the sciences and other growing disciplines, it is often necessary to create new terms which have precise definitions. Also, many familiar words are redefined for special purposes; in psychology, for example, many common words are given technical meanings. The following instances of definitions used as principles are found in educational psychology:

> Learning is experiencing and doing.
> Learning is complex and dynamic.

The first statement is a definition that states the components of learning, that is, the components which someone has *decided* should be so regarded. The statement seems to mean that when there is both experiencing and doing there is also learning because experiencing and doing compose or define learning.

The second statement is another kind of definition. It indicates the *qualities* which have been assigned to "learning." The words *complex* and *dynamic* do not equal learning; they are only properties of it. Learning is the process and *complex* and *dynamic* indicate two features of the process. Therefore, the statement is not a complete definition. It does, however, serve to delimit and sharpen the meaning of learning; and so in that sense it functions as a definition despite the fact that it lacks completeness; that is, it fails to furnish words that can be fully substituted for *learning*.

It is the opinion of the authors that definitions should *not* be treated as principles because the term *principle* should be reserved for those statements that can be verified by empirical evidence. A definition is an arbitrary rule concerning how a term is to be used. A principle, on the other hand, often starts as a hypothesis, gains support from observed

facts, and thereby is given the status of a "principle." A principle *depends* on *evidence* to determine its validity. A definition is made by fiat, decree, arbitrary choice. Its survival depends on whether people are willing to accept it and use it according to the original decree. Dictionary definitions amount to meanings that have gained some acceptance without guarantee that future arbitrary decisions will not be made to add new meanings that may supersede the old.

Principles that Function as Truisms. A statement that is self-evident is a truism. The function of a truism is not an informative one, but it serves as a memorandum about something that is deemed worth keeping in mind. It can be argued strongly that truisms ought not to be presented as principles, which should at least be informative and capable of being demonstrated. The following are examples of truisms which have been treated as principles:

> The goals and methods of teaching should be geared to the developmental level of the learner.
>
> The end products of learning which are accepted by the learner are those which are meaningful to him and which satisfy certain needs.
>
> The learner will stick to a learning task to the extent that he values the goal.

The first one is a truism because not even beginning education students need any supporting evidence in order to accept it. It stimulates unanimous agreement, but it does not have power because it does not suggest *how* the teacher should gear the methods of teaching.

Sometimes a statement is a truism because it is circular. Upon inspection it is seen to be something like the statement "all soldiers are soldiers." The third example above is virtually circular. It states that the learner will keep trying to

the extent that he values the goal. But what is the evideoce that hc values the goal? If we say that the evideoce is found in how persisteot he is in trying, then we have a truism that is circular because it amounts to this: A learner will keep trying to the extent that he keeps trying. Principles that function as truisms are statements that are self-evident, that is, they are only pscudo principles.

Principles that Function as Articles of Faith. The ceotral value of articles of faith in science is that they serve as longitudinal stimuli, that is, they tend to sustain action in a certain direction. Prime examples of articles of faith are found in religions. Faith stimulates perseverance, which can be fruitful when the eoergy is speot on solving problems that add both knowledge and power to the reservoir of a culture.

Let us examine just one article of faith that could serve to mobilize energy to bring about a revolutionary change in education and modern culture. The article is simply the belief that *the average person has only a small fraction of his learning potential actually developed.* There is no overwhelming evidence for such a belief. However its acceptance by able researchers in education and learning could conceivably lead to discoveries that may eventually verify it. If the point could be reacbed such that the learning potential of people could be increased *ten-*, *twenty-*, or *thirtyfold, then* the ensuing social revolution would make the current nuclear age seem a rather mild development.

Principles that Function as "Static" Ioformation. Perhaps the majority of statements treated as principles in education's psychology can be classed as "static" information. We mean by "static" information that knowledge which is meaningful to the practitioner but which has no application for him. It can be irrelevant, that is, beside the point, or it can be quite relevant without adding any power in decision making and

action toward solving practical problems. Perhaps one reason why some able students in educational psychology express discontent with course content is that they see much "static" information which either cannot he used in teaching or which has not been processed to the point where its use is apparent.

Examples of "static" information principles include the following:

> Differences in school achievement among students are related to individual differences in personality traits.
>
> The effect of a teacher on a pupil depends in part on the background of both the teacher and pupil.

The first principle is static to the extent that the teacher is unable to use the information to make any practical decision. The statement is too indefinite to be functional. Secondly, if teachers cannot do much about the personality traits of pupils, then the information emphasizes an area in which the teacher has virtually no power. Although the teacher may derive some rules about how to group pupils from such knowledge, the principle would be more meaningful if it indicated which traits influence school achievement.

Some statements are both informative and instrumental. Others lack one or both of these aspects. If a principle points up a reliable relationship which can be controlled by the teacher to improve or understand some condition then that principle has application value. It is believed that many "static" principles could become functional through a processing that would begin by developing some "how" statements, which would act as hunches or hypotheses and tested in practical situations. Knowledge that is relevant but nonfunctional in solving problems we call "static" information.

Principles that Function as Sources of Power. When a statement is informative, instrumental, and pertinent to a family of problems, then it is a potential source of power in dealing with the set of problems. As mentioned before, power principles should deal with a descriptive relation between at least two key terms, which can be used to name things in the practical situation. In addition, the key term which acts as the "cause" of an indicated change should be manipulable or come under the control of the practitioner. A power principle, then, can be processed to function as a useful tool. Since most of this book is given to the processing of power principles into operating rules, no examples will be treated here. Principles that function as sources of power are found in statements which are informative, instrumental, and pertinent to a family of problems.

SUMMARY

In this chapter we have chosen a practical problem of the teacher. The problem was stated in the form of a question, namely: *How can the teacher help students acquire subject matter efficiently?* A viewpoint of the educational phases in learning subject matter was outlined to provide a perspective for seeing how the chosen problem is related to other aspects of academic learning. An attempt was made to clarify the key terms in the problem and to point up two assumptions basic to the query. The analysis of the problem continued with identification of certain facts that represent the aims of teachers. Those aims were attempts to help the pupil acquire new ways of behaving, to strengthen existing weak responses, to weaken undesirable acts, and to promote self-control.

Further analysis revealed that all forms of teacher influence can be reduced to ways of stimulating students. Also, before any given principle can be applied it should contain some indication or suggestion of the kind of things that can be manipulated by the teacher to stimulate the desired behavior. Examination of three principles illustrated the value of rules derived from features called "observable operations" and "deliberate manipulation." A final section identified several kinds of statements which are presented as principles in educational psychology. Reasons were given as to why some of the statements should not be accepted as principles.

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CHAPTER 3

Standards of an Applicable Psychology

SOME TYPICAL FORMS OF MISAPPLICATION

STUDENTS OF educational psychology often expect to be provided with a "pat" formula which can be neatly applied to each particular problem they expect to meet in professional life. They seem to feel that an outline ought to be provided which will make the solution of each problem clear and easy. The attitude here, of course, is that an educational psychology should be an "applied psychology," in that it should have specific utility. Students of education are often reinforced in this attitude by philosophies which state that the learner need but learn broad principles and then use these principles to point the way to specific applications. This school of thought strongly believes in a high degree of "transfer" from general to specific.

It is an assumption of the authors that the general-to-specific approach, inherent in the attitude mentioned above,

is in itself less fruitful than the reverse direction. Teachers ought to become acquainted with typical classroom problems and then learn bow to determine which psychological systems can best meet the needs. If general principles are taugbt, and the teacber is left to his own devices in applying the principles, it is likely that the results will be unsatisfactory. Principles are often nnly vaguely understood wben studied, later dimly remembered if at all, bence misused when needed and perhaps even rejected. The following discussion of some typical forms of misapplication is concerned not only with a failure to communicate original meanings, but with inability to relate these meanings to a new context.

Labeling. The appropriate use of labels is certainly desirable. When we apply a label to a jar of jelly by writing *jelly* on a picce of paper and gluing it to the jar, the utility is undeniable. We attach the tag with confidence that its meaning will not be misunderstood and that all who read it will need nothing more in order tn make a choice between it and other items which have mucb in common with our labeled jar. Unfortunately, however, there is another kind of labeling which does not serve its intended purpose adequately.

Labeling something with psychological concepts may be insidious rather than helpful. The user too often attaches a tag while remaining partly in ignorance of the contents. A verbal symbol may lack validity, that is, it may fail to act as an accurate representative nf the event, object, or concept which it is supposed to describe. When the symbol is used for tagging something not really understood and not well represented by the tag, we may call such a naming process "labeling." The "referent" is supposed to be wbatever the label is representing. The user nf labels, however, does not have any real understanding nf the referents of the labels.

Because the label may serve in making quick, offhand judgments, we sometimes find that people who have good memories can easily acquire extensive vocabularies filled with labels. Unfortunately, good memory may serve misunderstanding as well as understanding. Catch phrases, slogans, nicknames, special jargons, and verbal catchalls serve a common purpose, that of furnishing convenient tags. When a speaker is able to dip quickly into his bag of labels and come up with a tag for each occasion, his smooth delivery is sometimes confused with intellectual acuteness. We find examples of this label-laden individual in the pedant, the prejudiced, and in the ignorant.

The careful student also has at his command a large array of terms, but he uses them economically. This is not to say that he is always sparing in the use of new or unusual terms —for there are occasions when only certain words are quite adequate. It does mean that the scholarly learner takes care that the terms he uses are both adequate and free from sheer verbal display. He strives to use terms which are relevant to what is being discussed.

The behavioral sciences have sometimes been criticized for coining "catch phrases" and for dealing in closed systems. "Closed systems" are explanatory attempts which explain their referents in terms of the systems. Circular reasoning is expressed in closed systems which are especially inappropriate in scientific inquiry. An example of circular reasoning is found in definitions given by young children: "A cat is a thing that fur grows on. Fur is what grows on a cat." Some psychological systems also involve similar reasoning. Various inner forces are postulated, and other states, forces, and tendencies are assumed, with their existence based on the acceptance of the invented inner forces. Concepts should eventually be referred to some observable events if they are

to serve useful functions. The closed system must be avoided, and thinking must be removed from the inferential circle. Vague terminology connected to practical problems by poorly defined relational terms may serve as a too-handy tool for misapplication. As indicated in an earlier chapter, it is extremely difficult to use a principle if the key terms cannot be related to some manipulable variable.

Concepts which permit of easy labeling enable the user to engage in glib verbal display, and perhaps also to make quick judgments, but they also leave the speaker in ignorance. While a concept term ought to refer both to a discriminated referent and to a generalized one, a label usually lacks discriminative power. Consequently, the labeler deals in imprecise terms. He may even hide behind his labels to avoid responsibility for investigating more adequate concepts.

Misapplication of psychological concepts may be found in any one or all of three areas of labeling:

a. A label is attached to a poorly understood psychological concept.

b. A relational term may itself become a label.

c. Problems in the classroom may be labeled.

An example of a statement which labels in all three areas would be "The child's underachieving is related to feelings of insecurity, causing poor adjustment." The following paragraphs show examples of labeling and illustrate how such terms may be used as subterfuges for teachers who find it difficult to do anything toward solving many of the classroom problems with which they are faced.

Labeling the Psychological Concept. Psychologists are concerned with man's adaptive behavior. Man modifies his behavior according to his many environments and undergoes changes under the control of his physiology and his back-

ground of experiences. He is necessarily a plastic organism, molded by environment to such an extent that with every turn of events he must make some kind of adjustment which will enable him to remain in the stream of events. The adaptive concept does include man's efforts to manipulate his environments as well as to be affected by them. Yet teachers are too often left with but a part of the idea, and since the label is convenient, they retain the label while discarding much of its referent. The label is usually something like "poor adaptability." Johnny is therefore said not to be "adapting well" if for any number of reasons he does not conform to a preconceived standard set up by the teacher.

The Relational Term May Become a Label. A principle in an applied field has a relational term which connects the concept with something in the applied area in a functional way. The relational term ought to be simple and precise. Instead, it often has vague reference to the relationship, such as does the connector "depends on." To say that one thing depends on another is to say that the intended meaning lies somewhere within a range of meanings such as "follows upon" or "has some slight bearing upon" or "cannot follow unless." For example, if my carrying out a certain behavior "depends on" how I may be feeling at the moment, along with other important determinants, then "depends on" has poor or weak utility. We may say that it has low relational power. But suppose my life "depends on" the strength in a length of rope which is suspending me over an abyss—then this relational term has acquired increased relational power. The meaning is more accurately understood than in the vague relation.

Behaviors in the classroom are quite easily labeled when they are but vaguely understood, yet require some name so that they may be conveniently placed in their slots. "Emo-

tionally unstable" may refer to anything from a slight tendency to squirm in a seat after being imprisoned there for more than an hour to frequent explosive outbursts which disrupt the entire class. Or perhaps the label is tacked onto a class member who is disliked.

Labeling does not always occur in all three areas. It works harmful effects even if it is used in only one. If labels are frequently applied in all three, however, it may be seen that labeling can be an extremely disruptive form of misapplication.

Reification. To reify is to convert an abstraction into a supposed real thing. For example, what Freud called the "Id" is an abstraction, and we may reify it and other Freudian abstractions by treating the various hypothetical forces as if they compose some sort of "little man" residing inside the person and directing his behavior. In reification the practice which brings about confusion is often the change from adjective or adverb to noun. A *way of behaving*, for instance, is converted into a *thing* which is regarded as part of the behavior.

Sometimes psychological notions are put into graphic form to make them easy to grasp. The unsophisticated student, however, often mistakes the intent of the graphic form by interpreting it to stand for a physical or material model of the idea. He therefore tends to think in terms of the tangible although only abstract ideas (constructs) are intended. Further contact with the constructs of psychology would develop an ability, perhaps, to use such models in the manner for which they were designed. But the average teacher seldom gets beyond the introductory stage, and in the words of some of the teachers themselves, he is taught only "watered down" psychology. There is small wonder then that after leaving

college the teacher tends to remember the models instead of the constructs.

A drive is inferred, as an internal state, and is neither observable nor directly manipulable. Yet the drive becomes a *thing* from which the teacher makes other inferences, in reification. He may speak of Johnny as "having low drive" for doing his school lessons. He thereby implies that some *thing* is missing from Johnny's internal equipment. The error could be avoided by saying that Johnny does not perform well academically. There would be no need to infer an inner object as causal of observable behavior—the behavior would merely be noted. The known fact is that Johnny *does* not perform well—not necessarily that he *can* not. However, the first interpretation relieves the teacher of his responsibility for providing proper conditions or contingencies for helping Johnny to improve to his maximum extent.

The constructs (verbal constructions) "id," "ego," and "superego" undoubtedly have served a useful purpose in clinical psychology. But those who have neither the time nor inclination to study Freud's system sufficiently for a grasp of the symbolic structure nevertheless use the terms. Ways of psychic behavior are therefore converted into spheres of influence or even into objects. It becomes almost fashionable to speak of a person's "weak ego" or "strong ego" or of the "battle between the Id and the Ego."

One more illustration of reification will suffice. "Feelings of hostility" are inferred from one or more instances of observed aggressive acts (sometimes they are also inferred from "aggression turned inward"). Insofar as the acts are merely described, no harm need be expected. It is not uncommon, however, for teachers to reify from an individual's tendency to behave aggressively to his actually having a

thing which they call "hostility." "Hostility" is treated as an object which ought to be extracted like a decayed tooth rather than merely recognized as a probability of action which may be reduced by manipulating something in the environment to influence the pupil to alter his behavior.

Overgeneralization. In effect, overgeneralization amounts to a confusion in logic. "*Some* A is B" becomes "*All* A is B" or "*Most* A is B." Although classification terms, principles, and other generalities serve useful purposes in denoting similarities that run throughout a range of psychological facts, the generality cannot be extended indefinitely. One of the best-known forms of overgeneralization results in the stereotype.

A stereotype is formed when the descriptive term which seems to fit one or a few cases is subsequently used to describe all members of a given group or class. Racial stereotypes are hardly less common than those stereotypes which assign certain roles to the sexes. The belief that man is aggressive and woman is passive or gentle implies greater generality than may be warranted. Early in life we learn slogans, mottoes, and maxims which represent overgeneralization. When we overgeneralize, we overlook the fact that each case rests on its own merit. Useful generalizations can become pernicious overgeneralizations.

Teachers may overgeneralize with respect not only to the clichés, proverbs, and so on, but to the value judgments which they pass on to students. The well-known halo effect comes about through overgeneralization.

Overgeneralization with respect to psychological principles is insidious in its effects. Learning the principles of any discipline is supposed to permit application of them to specific cases. If the principles are applied to cases for which they are

not appropriate, then we do not have generalization, the *useful tool*, but overgeneralization, the undesirable habit.

"Johnny is not motivated to do this work." This is a statement which appears frequently in the jargon of teachers. The overgeneralized statement has a tendency to direct attention away from two important aspects of the situation with respect to Johnny. The first is the direction of behavior. Johnny is certainly motivated, but into what channels will his energies fall? The teacher's problem has not been understood, because it has not been realized that there is no problem of "motivating" Johnny, but rather one of influencing his choice-points. The second aspect is concerned with intensity. What are the chances of Johnny's moving in the desired direction? Can the teacher provide stimuli so that Johnny's energies will produce desired educational outcomes?

What does it mean when a teacher says that Johnny is "emotionally blocked"? Does it mean that he is unable to express an emotion or any emotion? Does it mean that an emotion is blocking some psychic process? Blocking it from what? We may assume that the teacher means that some emotion has interposed its effects between a rational process and its desired end. Presumably, emotion in general is constricting reasoning. Again, this is such a broad, overgeneralized statement that unless a number of other statements are appended, it has little value. Because the teacher is not expected to be a therapist, it is likely to relieve him of at least some responsibility for shaping Johnny's academic behavior, if he can say that Johnny is "emotionally blocked." The implication of the teacher is, "What can you expect me to do in such a case?" It provides the teacher with a better excuse than merely to state that on a specified number of occasions Johnny has not recited or written or otherwise shown evi-

dence of a grasp of lesson material, and that he also has an experiential record which increases the probability of difficulties which the teacher had described as emotional.

Ambiguity. An ambiguous stimulus is one which may be interpreted in more than one way, with each interpretation being considered neither right nor wrong. The stimulus object itself does not provide cues which are distinctive enough to impel the same interpretation by each responder. Although there is wide latitude for private interpretation, there is also *some* structure, *some* pattern provided by the stimulus, which may be objectively determined. Yet, grounds for common agreement are reduced, when the stimuli provided are ambiguous.

Ambiguity can be reduced or cleared up by making the situation more amenable to objective interpretation. But many situations which seem to require objectivity remain ambiguously structured. If concepts from a psychology are stated in ambiguous language, or if the classroom situation is described in ambiguous terms, then there may be as many interpretations as there are schools of thought. Sentence structuring may be at fault. A criticism often leveled at so-called "objective" type quizzes is that items are stated ambiguously. Though the student may have the knowledge required for a correct answer, he may be unable to decide what is being asked. In an essay type test, the student may provide an answer that is couched in such ambiguous terms that the teacher cannot evaluate what has been said.

Educational aims such as "developing critical ways of thinking," "striving to develop an ability to appreciate the deeper values of life," when stated in such ambiguous catch phrases, lose much of their meaning. The use of ambiguous terms must lead to further definition or discussion, if any practical degree of precision is to be achieved. As Travers

points up, before the pupil can be evaluated efficiently, it is necessary to state educational goals in terms of definite changes in pupil behavior or simply in the form of a list of straightforward actions on the part of the learner.

Must educational psychology still be burdened with a terminology which fosters undue vagueness? Keislar suggests that such terms as *interest, need, goal, desire, aspiration*, and the like, should be dropped in education as terms of explanation until their meanings are clarified by psychologists. He further suggests that the use of such terms promotes systems which lean heavily on ambiguous phrases such as "overprotected child," "suppressed or repressed needs," "state of readiness," "nonmotivated," "low need for achievement," "individual differences," and the like. (Many educators will insist that these expressions have served an interim function, as they await the emergence of a new educational psychology.)

Each of the four forms of misapplication have much in common. Labeling, reification, overgeneralization, and ambiguity all lead to overly vague interpretations. They tend to foster a language system in which so much uncertainty prevails that the first step out of the state of confusion is a difficult one. Fuzzy thinking about all sorts of problems in the classroom is much more probable when terminology and concepts are so loosely handled, as is the case when labeling, reification, overgeneralization, and ambiguity enter into attempts at application.

Who or what is at fault if such widespread misapplication exists? Perhaps some immediate causes may be found in teacher practices, the psychological instruction of teachers, and psychological systems which have been carried over almost wholesale into educational areas where they have little real application.

Many teachers welcome the opportunity to learn more about how they may perform more adequately. Experience in teaching ought to include reevaluation of old ideas and development of new ones. Fortunately there are current offerings in psychology which are being developed specifically for educational applications. Teachers can supplement formal training through the reading of professional journals and fraternal magazines, as well as through books, convention speeches, and meetings of special associations.

"Passive learning" in college courses is also likely to suppress efficient use of psychology in teaching. The teacher-to-be reads about concepts, hears them discussed, and may even be invited to recite occasionally. But this does not guarantee that the trainee will be able to recognize situations in which the concepts ought to be applied, nor even that he will be able to apply the concepts if he does recognize relevant situations. (An important counterbalance to the passive learning situation is provided by student teaching programs —provided that the student is permitted to be active, rather than merely to watch.)

What of the psychological systems from which educational psychology has borrowed? Most teachers would agree that *learning* is closely associated with the educative act. Yet the educational implications from learning theories have been so neglected that only token and surface ties have been indicated. A common excuse given for such scant development of learning theory in education is that the psychologists have formed their theories largely from the study of lower animals. This argument lacks cogency, since a number of terms found in theories concerned with animal learning already have definite meaning and value in the study of human learning behavior. Examples include such terms as *reinforcement, deprivation, reinforcer, schedules of reinforce-*

ment, avoidance learning, extinction, stimulus discrimination, aversive stimulus, stimulus control, operant behavior, goal gradient, and *stimulus generalization.* The practical value of learning theories simply has not been exploited. Since Thorndike, the responsibility of showing how psychology can be applied in education has been almost ignored.

Insistence on applicability is the theme of this book. To be applicable, however, concepts must be reasonably precise, preferably to the point of quantification. More important than quantification, however, is the property of manipulability, especially with respect to the presumed causes of learning.

CRITERIA FOR CHOOSING A PSYCHOLOGY

The preceding chapter presented an attempt to determine the demands of the teacher's problem. The demands of the problem determine the kinds of tools which can be successfully applied toward problem solution. Analysis is important, even though it may not point out the *complete* kit of relevant tools. In this chapter we shall identify special standards or criteria for choosing a psychology and for dealing with the chosen problem. While we have chosen only one problem for the purpose of illustration, it is felt that no matter which problem of education is chosen, the *approach* indicated can be used for selecting an appropriate psychology and for putting it to work.

We said that the practices of teachers can be classed under "attempts to influence." Three components of teacher influence were said to be *stimulation, observable operations,* and *manipulation.* These will be used as bases for selecting a psychology.

"Principles of stimulation" should be contained in the psychology. Stimulation is central to all influences that the teacher can exercise. A number of psychologies meet the criterion, but some meet it more fully than others. We shall examine the use of this criterion in the next chapter.

It should be convenient to classify the observable parts of a teaching problem under terms in the borrowed psychology. In order to describe behavioral events, one psychology deals with unobservables, such as the unconscious and its presumed functions. Another psychology uses descriptive terms that stand for observables, such as reactions to specific things in the environment. We prefer the second kind of psychology, since it deals with observables. Unobservables are not unimportant, of course, but *most* psychological terms which refer to unobservables are not yet sufficiently developed to have acquired a clear utility for teaching. Standard meanings have not been established for the terms, and no clear chain of action has been worked out to link the terms to specific things or processes. Because of this, it is difficult to avoid the dangers of labeling, reification, overgeneralization, and ambiguity. *A psychology with key terms that refer only to unobservable events cannot directly be used to classify the observable operations of the teacher without making errors of misapplication very probable.*

Perhaps our concern about observables may be summarized in this way: The teacher tries to influence the pupil by many identifiable, physical actions. If such actions have any real influence on the pupil, they should be represented in the psychological statements used to describe the teaching process. Having reached the point of proper assignment * of

* Any practical field that employs technical terms from another discipline is faced with the problem of assignment. The problem of assignment lies in the task of using technical terms to stand for things in the applied area. *Reinforcer*, for example, must stand for things in the classroom. A borrowed

things in the problem to the borrowed terms, we have set the stage for effective application.

The psychology must include terms which name manipulable things or processes that influence behavior. Communication is a necessary part of teaching. It is mediated by manipulation of verbal symbols and concrete things. It should be clear that the psychological principles which we wish to test for utility should deal with propositions about the effect of things that can be manipulated. Without some form of manipulation of observable things, including symbols, the teacher could not perform the functions of teaching.

Our criteria so far have emerged from the demands of the teacher's problem. Let us identify other criteria for selecting our psychological tools.

The goals of teaching and the selected psychology should be similar. The criterion requires that we first determine which important goals of education are involved in the teaching problem. Then we must look for a psychological system which is also based on goals which are parallel to those in education. We can restate the problem: "How can the teacher stimulate the pupil toward efficient learning?" Or "How can the teacher manipulate the tools of teaching to stimulate the pupil to achieve course content efficiently?" In a more formal phrasing of a psychology of learning, the same problem can be expressed as: "A particular response pattern is a function of what manipulable independent variables?"

Why is it important to seek out similar purposes underlying the teacher's problem and the psychological system? Psychology is no single, well-ordered discipline. It is a loose-knit family of systems, all of which are attempts to describe

term has power when it stands for things in the classroom that have important influences on the pupil. Power can be developed if the psychology provides principles which show how the causal term is related to the effect or outcome.

and to account for behavioral phenomena. It is difficult to determine how many reliable principles exist in psychology to such an extent that they may be held as basic throughout all its fields. Until such a substantial core becomes recognized, each system is relatively autonomous.

The principal applied branches of psychology are industrial, educational, and clinical. Educational psychologists, in general, are eclectic, that is, they use any idea that seems to work regardless of what theory it belongs to. While the clinician's work may be considered a kind of teaching, his problem is not one of stimulating the pupil to learn spelling, chemistry, English, or history. Instead, it is the task of helping the client to see the nature of his self-conflict with the hope that once he has seen the presumed cause of his problem, he will then make the necessary change toward recovery.

The teacher's problem as we have defined it has less to do with the unconscious and more with the conscious, intellectual processes than does the clinician's task. But when clinical psychology is used in education, the emphasis is on emotional adjustment rather than on subject matter in the curriculum. While emotions may have a great deal to do with intellectual learning, clinical practices are pretty much confined to helping in the restoration of emotional balance. The clinician is not primarily interested in aiding the client to get information quickly and easily, manipulate ideas, analyze meanings, learn how to develop sound generalizations, integrate concepts, and become skillful in using abstractions in relevant situations.

The fundamental concepts of psychology should have sufficient range of generality to be useful for describing learning among different species of animals. Some concepts

in psychology have a very limited range while others retain significance throughout radical changes in conditions. Most of psychology was not developed with educational problems as central issues, but some psychology is pertinent to classroom processes.

Spence has said that pervasive concepts arise from scientific efforts which deal with simple rather than with complex problems. Also, they tend to come from basic research rather than from research stimulated by urgent practical needs. Spence indicated that variables which seem to be important in complex situations often lose their significance when the situation is only slightly changed. Such variables are said to *have a low order generality. They may be important, but not* important throughout a wide range of conditions.

Most basic research in learning has been carried out in experiments with animals. Accordingly, we would expect to find the most general notions in the psychology of learning to be based on the study of lower animals. Teachers find it difficult to accept this expectation on the ground that humans are different from lower animals. The mere fact of inequality, however, does not imply lack of *similarity*, nor does it suggest that no practical relations can exist between unequal things. The objection is based on the obvious differences between species without recognition of possible similarities. The very significance of a generality lies in the fact that it holds despite the presence of obvious differences.

An example of a broad concept, coming from studies on animal behavior, is "reinforcement." (It will be examined in detail later, along with other concepts.) Studies have shown that "reinforcement" can be used to describe learning in rats, mice, dogs, pigeons, monkeys, and humans. Because of the demonstrated fact, we say that the term is pervasive and

therefore that it is likely to be useful in the study of learning in the classroom.

In the psychological principles, the relation terms that connect the stimulus (the environmental influence) to the change in behavior should be specific. If we are to deal in practical principles, we require terms that indicate relations. Sometimes the relation term is lacking in precision, such as in the statement "*Learning depends on motivation.*" The vagueness of the relation term *depends* limits its usefulness. The relation ought to suggest the kind of action as well the direction of the action. Teachers wish to have learning principles which point up those things which they can present, remove, or alter in order to influence learning.

SUMMARY

The criteria for selecting a psychology are restated and placed in the order of their use in the next chapter.

a. The psychology should be based on a purpose similar to the one found in the problem of education.

b. Key terms in the psychology should be appropriate for classifying the important events in the practical problem.

c. The psychology should include concepts of such general significance that they can be used to describe the management of learning throughout a wide range of organisms.

d. The psychology should emphasize the importance of environmental influence on behavior.

e. Key terms in the psychology should represent *manipulable* variables of influence.

f. In the psychological principles, the relation terms that connect the source of influence with the change in behavior should be specific.

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CHAPTER 4

Selecting the Psychological Concepts

It is proper to regard psychology as a variety of systems rather than as a single discipline. Each system of psychology has its own set of basic ideas, aims, methods, and interpretations, although considerable overlap may exist between some systems. The problem in the applied fields is to discover which concepts are applicable to specific tasks and to develop efficient means of implementation.

The useful connections between education and psychology are not yet adequately determined. It is believed that progress here can be speeded up by developing *systematic* modes of application. The plan outlined in the first chapter calls for criteria to serve as grounds for selecting the psychological tools. The value provided by our criteria is to maintain an orientation toward a definite problem in education to prevent acceptance of irrelevant and clumsy tools.

It is not possible to make a detailed description in this limited volume of all the psychologies and how each one

meets our criteria. In the interest of brevity we shall deal only with two illustrations, showing how judgments can be made on the appropriateness of the psychology to the teaching problem we have chosen.

Our analysis proceeds by first identifying the problem central to the psychology; then the necessary ideas will be identified; then the methods of investigation will be determined; finally, a sample of educational implications will be presented. A brief treatment on the nature of the key terms will be followed by judging the application value of the psychology according to the chosen standards.

AN EVALUATION OF FREUDIAN PSYCHOLOGY IN NONTECHNICAL TERMS

Any brief treatment of a system so extensive as Freud's must necessarily do violence to the system, through oversimplification. Our purpose, however, is not to provide an adequate overview, but to identify certain features of the system that bear upon its relevance to the teaching of subject matter.

The Problem. Two kinds of problems have entered into the development of most psychological systems, a theoretical problem and a practical one. Freud's theoretical problem was to describe and account for the motivating forces of human beings. His practical problem was to help people suffering from functional (emotional) disorders, which are ailments that seem to lack physiological causes.

Necessary Ideas. The following notions in the Freudian system seem fundamental:

a. *All behavior is motivated.* There is nothing that a human can do which is not brought about by some motive. There-

fore the whole domain of human behavior comes conveniently under the study of motivation. If this notion were not accepted then there would be some forms of behavior which could not be accounted for on the basis of motivation; consequently, the psychology would be less comprehensive than it is.

b. *All behavior is meaningful* (regardless of how nonsensical it may appear to be). The idea here is closely connected to the first one. Thus, all behavior can be accounted for in terms of a coherent theory. Being able to make sense of any sort of human action provides a basis for broad significance of the psychology.

c. *The causes of behavior are not seen directly.* Since some behavior seems nonsensical by direct observation, it is convenient to say that the real significance of any act must be interpreted rather than taken directly from the behavior itself; that is, all observable acts are symbolic and cannot be taken at face value. The overt response symbolizes action in the unseen headquarters of motivation. When one suffers from an emotional disturbance, it is unwise to treat merely his symptoms because they do not contain their own causes.

d. *The person is aware of only a small portion of the motives* (which cause him to act, feel, imagine, and want). If the person is unaware of most motives which cause him to behave, he must be unconscious of the real reasons behind his actions. Consequently, self-treatment of deep emotional conflicts is not feasible. One must seek the help of someone who knows the nature of human motivation.

e. *Motives fall into different classes and are not compatible.* The urge to gulp food, for example, is at cross-purposes with the desire to obey social custom that calls for more sedate action. A person becomes mentally unbalanced as a result of motives at war in the realm of the unconscious.

f. *Motives form a structure that develops according to certain laws. The structure solidifies at an early age.* Before solidification occurs, the seeds of abnormality are planted as the individual experiences various kinds of stress. The seeds lie dormant so long as stress is not overpowering. When the person comes under prolonged strain, however, one or more of the abnormal tendencies will grow. The person finds himself at a loss to cope with the problem because he is unconscious of its causes. Improvement must come through psychoanalysis, which is the process of making known to the person the real causes of his trouble after careful analysis of many samples of his behavior. The only way to influence or relieve damaging psychic pressures is through psychoanalysis.

Method. The professional way of applying Freudian theory is through the act of psychoanalysis. The primary task in making the treatment effective is proper diagnosis, which requires the expression of many spontaneous verbal reports by the patient. The analyst studies the verbal reports and attempts to build a history of emotional stress of the patient. He interprets the data according to the theory and makes the results known to the patient. It is assumed that once the patient becomes aware of the real causes of his trouble his conscious self will make the needed adjustments to bring about a satisfactory balance among the unseen motives.

Some Educational Implications. The sample of implications provided here is by no means exhaustive. Items are sufficient, however, to indicate the kind of relations that this psychology has established with education.

a. Education is a process of becoming acquainted with reality and *tends* to replace the more primitive striving toward immediate gratification. The result is not complete replacement of the motive for immediate satisfaction, but a compromise, seeking objects of desire in the environment rather than finding pleasure solely within the self.

b. Teachers of young children such as found in nurseries, kindergarten, and perhaps in the first two grades can make the most lasting impressions on children. Teachers dealing with young children should be well informed on the nature and development of the psychosexual structure. Things that teachers should avoid are stressed more than things that they should do. In general, teachers should avoid frustrating the children to an undue extent.

c. Teachers ought to be sensitive to signs of deep-seated disturbances so that the pupil can be referred to the proper specialists and to guide the teacher's treatment (interaction) with the pupil. The teacher should keep the burdens of disturbed pupils relatively light and attempt to understand their problems, that is, take a sympathetic attitude toward them rather than a hostile one.

d. Teachers in higher grades cannot *improve* the psychic state of pupils, because the psychic structure has already been set. Teachers can do something to *maintain* conditions for mental health, however.

e. Learning efficiency requires a normal balance among competing motives, which are largely unconscious ones. If the balance is radically abnormal, then learning is impaired, because ability to deal with reality has been damaged.

f. Insofar as details of *how* the teacher ought to manipulate and arrange subject matter very little is implied by Freud's theory. Psychoanalytic notions emphasize the *state* of the person as being of great importance in determining his behavior. There is very little in the psychology that suggests how a pupil can become a scholar or how he can become proficient in the art of learning.

g. The important task of developing in the child an intense desire to learn is best accomplished at a young age, perhaps by age six or seven. There is an optimal time when the child is most susceptible to the uncritical acceptance of authority.

And that is the best time to instill a positive attitude toward school learning. Failure to do so will induce a handicap to efficient learning.

Nature of the Key Terms. We have said that a useful psychology should contain terms that identify things which influence the learner. At least *some* of the presumed causes of learning should be controlled by the teacher. The extent to which things that influence the learner cannot be manipulated by the teacher is a measure of the teacher's lack of power. How much power can the teacher realize according to the Freudian system? The answer has been suggested already. It was indicated that the teacher of the very young pupil can wield the strongest and most lasting influence. Later, teachers exercise a rather superficial kind of influence except when they may happen to unduly frustrate pupils. Thus, while teachers in the nursery, kindergarten, and first grade can profoundly influence the child either positively or negatively, the *profound* influence of teachers in higher grades is more likely to be negative, since the motive pattern has already solidified. The *major change* most likely to be made is through ego damage, especially when the influence is wielded outside psychoanalysis.

Since all behavior is said to be motivated, motive must be the cause of behavior. "Motive" is a term that stands for something not directly observable. It is inferred from overt behavior.

Apparently the reason for Freud's choosing causal factors which cannot be seen or directly manipulated was that he could not locate all influences in the environment. Hallucinations, the action of memory, forgetting, and self-deprecation did not seem to be simple reactions to outer stimuli. He was convinced that a notion of psychic energy located within was needed in order to develop a theory of human motivation. A

motive is both unobservable and nonmanipulable. It is a cause of behavior, but it is a cause which can, in turn, be influenced.

FREUDIAN PSYCHOLOGY AND THE CRITERIA OF APPLICATION

Freudian psychology has some relevance to academic learning, but its goals are primarily concerned with clinical applications. The management of cognitive learning is not basic in this system.

Efficient management of learning calls for effective ways of *structuring* material, *presenting* it, teaching self-evaluation, and utilizing efficient ways of *manipulation* (by the learner) of material for understanding and retention. While Freudian psychology uses key terms which permit classification of behavior and speculation on internal causes, it does not provide terms which specify environmental events which can be manipulated to produce cognitive learning.

There is some doubt that the notions of human motives are sufficiently general to describe accurately the causes of human action across radical changes in culture. Freudian tools are to be used for dealing with *emotional* problems. Learning is not merely a matter of emotional well-being, for intellectual stimulation is also necessary.

Freud had few if any clearly defined stimulus functions that could be controlled to influence behavior (except, of course, those manipulations unique to psychoanalysis). Formal education, on the other hand, is not designed primarily to work significant change in the pupil's inner structure (which remains remarkably resistant to change from external influences, once early childhood has been passed).

Psychoanalytic systems have not developed concepts which cover the controlling or management of stimuli for bringing about educational aims. In general, Freudian terms are descriptive of uncontrolled, and to a large extent unobserved, events.

Since the required stimulus terms should represent manipulable variables, the relation terms in Freudian psychology will not be examined here, because specificity is absent; that is, manipulable variables are not represented.

It is not claimed here that Freudian psychology is *generally* inadequate, but that it does not supply appropriate tools for this particular problem of the teacher. The criteria chosen apply only in a particular setting, and it is not necessarily felt that they are valid under other conditions.

It has been the purpose of the foregoing to show that not all psychological concepts are logically appropriate to a given teaching problem. It is even possible that the proposed practice (of analyzing the teacher's problem) may not have the most general utility. We have accepted it tentatively, hoping that the future will provide much support for it. There is a psychology which does contain the kind of concepts needed for application to the teacher's problem, so with the limitations of the criteria in mind, let us examine this system.

A PSYCHOLOGY OF FUNCTIONAL ANALYSIS

This system belongs to the behavioristic stream of psychologies, all of which share certain features. Some of the important shared properties include the following:

a. Environmental conditions determine a large portion of an organism's behavior.

b. Subjective (nonobjective) considerations should be minimized in drawing up the descriptive laws of behavior.

c. Psychological phenomena can be ordered and studied as a science similar to the kind of organization and procedures of study in the natural sciences.

d. There exists among the species of the animal kingdom a behavioral continuity (parallel to the physiological continuity claimed by Darwin).

The system known as Functional Analysis was developed largely by the efforts of Professor B. F. Skinner, who has been prominent among psychologists since the late 1930's. A nontechnical evaluation of his system is outlined below.

The Problem. There seems to be a difference of opinion on whether or not Skinner included a theoretical task in his problem. It is our position that a theoretical task can be identified. It can be stated as follows: to develop a set of descriptive concepts which can be used to identify contingencies between environmental conditions and observed behavior of all animals, including man. The laws of behavior are to be found through an experimental program with the least dependence on terms which stand for things assumed rather than directly observed.

The practical side of Skinner's problem is to determine how to manipulate things in the environment to bring about desired changes in the behavior of the organism.

Necessary Ideas. In addition to the notions common among behavioristic systems, the following statements make up a good sample of ideas that are typical of functional analysis.

a. The relations between behavior and external conditions are strong enough to make it unnecessary to appeal to physiological processes in accounting for changes in behavior. In addition, no speculations on internal functions, physical or mental, are needed to build a science of behavior.

b. Psychological behavior that has the most practical significance in society belongs to the class that is commonly termed "voluntary" behavior.

c. Voluntary acts are influenced by the consequences which they produce. Therefore, when the learner experiences the environmental reaction to his own action, he then receives the kind of "message" which often has a profound effect on his future behavior. For example, a small child who deliberately touches a hot stove very quickly learns how to behave with respect to the stove.

d. All behavior is apparently controlled (to some extent) by one or more sets of stimulus conditions. Some things in the environment are much more powerful controllers than are other things. Food can be used to control a hungry animal. Money can be used to influence people who have learned to use it.

e. Behavior should be described by the study of the individual under conditions which can be accurately specified. *How* one learns is more important in building a scientific system than *what* one learns.

Method. Skinner started his work by trying to find lawful relationships between behavior and environmental conditions. His main rule of procedure was to *control* the conditions which influence behavior. Highly controlled factors in his experiments were stimuli such as special sounds, shapes, and lights in the immediate environment of the learner. Also, rigid control was maintained over means of keeping a record of the occurrence of a specified response. The gathering of descriptive facts was typically accomplished by means of automatic devices which maintained continuous records even in the absence of the experimenter. The design of experiments did not follow any conventional statistical rules popular among social scientists. Experiments were almost always simple, straightforward, and highly controlled.

When *groups* are studied and scores are averaged as well as subjected to other statistical processes, the end result does not lend itself to accumulation of knowledge of *how* the individual behaved in the *process* of learning. Hence, this system *has developed* by organizing descriptive facts about *one* learner at a time.

Some Educational Implications. Implications will be determined by using a special "model" in the form of an ideal answer to the teacher's problem. The model, taken from the chosen psychology, will be used to analyze teaching practices. Results of the analysis will be in the form of operating rules which teachers can test in the classroom. Rules which survive the tests will become *substantial* parts of educational psychology. We believe that substance—the reliable knowledge in educational psychology that teachers can use—must come through the joint efforts of educational psychologists and teachers. It is only when the teacher can demonstrate the operating rules that we can say that educational psychology is properly applied in teaching.

Nature of the Key Terms. It should be clear that the methods which Skinner used to develop his system required observable and manipulable stimulus operations. Also, the measurement of behavior changes becomes *important*, because to determine the effect of any kind of control a record of changes of the learner is necessary.

THE PSYCHOLOGY OF FUNCTIONAL ANALYSIS AND THE CRITERIA OF APPLICATION

Although functional analysis seems to contain the features we have been seeking, it is fitting that we clarify the extent to which this psychology meets our criteria of application.

a. *The psychology should be based on a purpose similar*

to the one found in the problem of education. The practical problem of Skinner's psychology was said to be a quest for ways of manipulating the environment to influence the learner in some definite fashion. The teacher's problem is: *How can the teacher help pupils acquire subject matter efficiently?* Analysis of the teacher's problem, given in an earlier chapter, indicated that the main demands were for observable and manipulable stimuli. Since the practical side of Skinner's problem is very similar to the teacher's problem, and since the main demands of the latter are apparently met by the psychology, we think that this first criterion is met satisfactorily.

b. *Key terms in the psychology should be appropriate for classifying the important events in the practical problem.* Let us be reminded of the key terms earlier identified in the teacher's problem. They were *subject matter, acquire, efficient,* and *help.* After the problem had been analyzed it was seen that "subject matter" amounted to those things in the course that were to be recognized and recalled. In the psychology presently under discussion, "subject matter" refers to a kind of stimulus set and can therefore come under the general term *stimulus.* "Acquire" refers to both the presentation of subject matter and the behavior that the learner must manifest in order to recognize and recall the material. "Acquire," then, means a class of behavior and therefore is composed of a family of responses. (In the psychology of functional analysis the term *operant* is the most appropriate term, one which will be covered in the next chapter.) "Efficient" refers to the quality of the teacher's influence which decreases time and effort in learning. It is determined by accumulating measures of learning for each pupil across a time span. The word *help* refers to all the specific things that teachers can do to promote efficient acquisition. In this psy-

chology, those specific things come under terms that describe how stimuli are managed.

c. *The psychology should include concepts of such general significance that they can be used to describe learning throughout a wide range of organisms.* Such terms as *reinforcement, extinction, operant behavior,* and other terms found in a functional analysis of human learning have been found to hold for human learners in essentially the same way as they have been used to describe learning by lower animals.

d. *The psychology should emphasize the importance of environmental influence on behavior.* It has been already indicated that the chosen system is based on the task of finding the stable relations between environmental conditions and behavior. We have also noted that the teacher is an environmental influence on the pupil. Therefore, from the standpoint of seeking to help the pupil learn, the present criterion is met by the psychology of functional analysis.

e. *Key terms in the psychology should represent manipulable variables of influence.* The chosen system is based on control, which was taken as a basic rule for carrying out descriptive studies of learning. Without control of conditions it is virtually impossible to determine which aspects of the environment are fundamentally related to changes in behavior. The selected psychology meets this criterion.

f. *Relation terms that connect the source of influence with the change in behavior (learning) should be specific.* The psychology of functional analysis is not an ideal system with respect to this criterion. A better choice would be a psychology that has its learning principles expressed mathematically. Unfortunately, no system that also meets our other criteria satisfactorily has its principles in mathematical form. Skinner's relation terms, however, are useful because they point up the *direction* of change in behavior as a result of

some influence. Many principles in psychology have very vague relation terms.

The criteria of application which were developed from an analysis of a stated teaching problem are reasonably well met by the psychology of functional analysis. Consequently, we should expect more *direct* application value from this selected system than from one that is considerably less relevant according to our standards.

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CHAPTER 5

A Psychological Model for Developing Operating Rules

We shall attempt to arrange ideas from Skinner's psychology in such a way that a useful model emerges. The model may then be used throughout the remainder of the book as an analytic tool for evaluating various approaches to teaching, such as the lecture, group discussions, field trips, and other well-known methods.

A brief résumé of the psychology, extending beyond the nontechnical overview already presented, is in order. Chapter 4 contains a general orientation, which may be called the philosophy of the system. It was pointed out that an analysis of behavior which is observable rather than one based on assumed inner processes is preferred. In a functional analysis, arrangement of the pupil's environment (the manipulable variables) is sought, in order to bring about maximum learning. The process by which one learns as a result of conseiquences of his behavior is called "operant conditioning."

LEARNING AND REINFORCEMENT

The student has often heard the aims of psychology stated as "prediction and control of behavior." In this book, *human* behavior is of first importance. Also, since we are trying to develop instrumentalities for more effective teaching, we are concerned with *control*. While *prediction* cannot be separated from considerations of control, it is not prediction which will be the center of attention. (Later, when we are setting up tentative operating rules, we shall be dealing with predictions.)

Successful control of behavior results either in maintaining the behavior in strength or in shaping (changing) that behavior in some manner. Thus, the meaning of "control" in the present context is the same as those aims pursued by teachers in the past—aiding the pupil in learning. But the most effective way of maintaining and shaping behavior (that is, teaching) is not to insist upon the acquisition of complex behavioral changes in large blocks. Rather, we must teach in small doses which may be adjusted to the progress of individual pupils.

OPERANT CONDITIONING—MAXIMIZING THE EFFECTIVENESS OF PUPIL RESPONDING

We shall speak of the pupil's response when we mean the relatively simple segment of behavior represented by such acts as asking questions, giving answers, performing a simple motion, or other behavior of brief duration. (Examples just cited are not merely responses, because each instance

amounts to a number of responses. For simplification in understanding operant conditioning, however, we shall speak of them as "responses.") When responses are initiated by the pupil, they are called "operants," because they represent manipulations or *operations* which change the pupil's environment, even if only in minute ways.

After a pupil has behaved in some way, for example, when he has answered a question (emitted an operant), the consequences may be then interpreted by him. If he sees the consequence following an operant as desirable, appropriate, accurate, or "good" in some way, the probability increases for his repeating the same *kind* of behavior when faced with similar conditions. Notice that we do not say that he *will* repeat the same behavior. Nor is it claimed that the probability is great that he will repeat the same behavior. But the *probability increases* that he will behave in a *similar* way. Thus, the technical way of stating what happens is: "Reinforcement of an operant increases the probability of repetition of operants of the same class." The first task of the teacher, if he is to aid the pupil via operant conditioning, is to get the student to express himself in some observable way.

REINFORCEMENT

Once a pupil has behaved, there is an opportunity for the environment to influence his learning efficiency. ("Environment" may be any educational influence—*social* environment refers to the teacher and other persons in contact with the pupil.) In common parlance the influences most likely to alter behavior are rewards and punishments or some promise of either, or a combination of rewards and punishments. "Reward" is the nontechnical term which is most nearly of

the same meaning as "reinforce." Technically, there are important differences which make the use of "reward" unsatisfactory as a synonym for "reinforce." At the moment we shall ignore the technical differences and concentrate on the idea that some environmental influences have a positive effect on learning while others have a negative effect.

There are two quite different ways of reinforcing. The first of these is called "positive reinforcement." If a pupil's act brings about something in the environment which influences him to repeat the act, positive reinforcement has been applied. The technical way of saying the same thing is "positive reinforcement consists of *presenting* reinforcers." Reinforcers in the classroom which can be presented by the teacher will vary from pupil to pupil, according to personal background. Let us examine some reinforcers which are available and which are often effective with many students. In dealing with verbal behavior, various ways of expressing approval may be reinforcing. Approval may be shown by confirming pupil answers, by encouraging the learner to continue his recitation, and by calling attention of the class to valuable points mentioned by the student. There are also other kinds of reinforcers. Tokens, such as school grades, awards of merit, symbols of recognition (gold stars, honor rolls, dean's lists) and special privileges all are used in the reinforcement of desirable behavior.

There is a second kind of reinforcement which also acts to increase the occurrence of some act or response class. It is called "negative reinforcement." There are situations in which the pupil does things which amount to stopping or terminating something undesirable. When students try to study, and there are distractions present such as noises, temperature extremes, glare in the lighting, or excessive movements in the field of vision, then, obviously, a termination of the distractions is to be welcomed. The unwelcome

stimuli are called "negative reinforcers." The technical way of stating the notion is: "The termination of a negative reinforcer is negative reinforcement."

EXTINCTION

Changing response patterns (shaping behavior) is not merely a matter of adding something. In many learning situations, before adequate learning can occur, there must be an "unlearning of established patterns." Both positive and negative reinforcement are means of *increasing* response probabilities. *Negative reinforcement is not a means of "stamping out" or extinguishing behaviors.* Letting a response pattern die out is accomplished by withholding of reinforcement. One way of saying this is that a behavior may be erased by not letting it be rewarded and by preventing termination of something undesirable. The technical statement is: *"Extinction occurs in the continued absence of reinforcement."* Some responses, even within the same class, that is, similar responses, are not treated the same by factors which are acting upon the pupil. For example, in spelling, the response s-o-m has three elements (letters), as the pupil writes or speaks, but his response is extinguished by the teacher and other pupils. The response s-o-m-e, which has the same three elements, along with an additional one, is reinforced by the teacher and pupils. As a result of similar patterns of his behavior being treated differently, the pupil learns.

DIFFERENTIAL REINFORCEMENT

We often hear of setting and maintaining standards in education. "Low standards" usually mean that passing grades

are easy to obtain and that few or no students fail, regardless of bow inferior their work is. "High standards," on the other hand, are often interpreted as being very difficult to reacb and are accompanied by a high rate of failure—only the most able students reach the goals.

Our psychology of reinforcement suggests that "academie standards" as just described support inefficient practices in teaching. Our psychology implies that an academic standard is "high" or "low" according to the amount of change that it demands on the part of the student. If the pupil changes his behavior very little in reaching a goal, he has not attained a high standard *within the given learning experience.* For example, if a high scbool student bas lived abroad, say in Germany, for two years and bas come to learn the foreign language well, then returns home and enrolls in a high school German course, it is likely that his ability to bandle German will not be altered by the course. The course sets no high standard for that student. A second student who is equally bright but who begins witb no knowledge of German may change his behavior very mucb as a result of the high school German class. While the second student may be far inferior to the first one in German facility at the end of the course, tbere is no doubt whicb student has been influenced more by the course. The first student had achieved a higb standard in German *before* enrolling in the course; the course represents for him a low standard.

A standard is measured by the distance the student must go to reacb it. A second measure of standards is the extent of refinement of behavior demanded. But "refinement" and "distance" do not necessarily involve difficulty. A child who is poorly instructed may have a difficult time in learning the multiplication tables, but the difficulty, per se, does not merit the name "high standard." Under efficient instruction the

same child may learn the tables in a very short time with great ease. The more difficult a course is for a pupil the lower the standard of *achievement* is for him. Efficient instruction is the means to high standards.

The reader should note that *setting* high standards and *implementing* them are two different things. It is useless to set the goals high if no one is able to reach them. Academic standards should be determined by the efficiency of the instructional means. Sometimes teachers point with pride to courses which only a few pupils can pass satisfactorily. According to our psychology, the teachers, instead of feeling proud, should be embarrassed for setting the standards beyond the instructional facilities. To weed out inferior students through increasing demands alone is to deal in the morose luxury of sacrificing learners at the altar of incompetent teaching. A student should never be discouraged from pursuing a field of study until he has been given the best available conditions for learning. When a child fails to learn, one should first suspect poor conditions somewhere in the learner's environment before accepting the conclusion of "low capacity." Such a democratic platform requires proper instrumentation. We believe that the psychology of reinforcement contributes something toward realizing that platform. The reference is to "differential reinforcement," which is described as follows:

When the infant takes his first unassisted step he is greatly encouraged (reinforced) by the proud parents. After the child learns to walk, he is not encouraged to walk after the manner of his first step. He is reinforced for *improving* his skill in walking. Differential reinforcement is given only when the performer has exhibited the proper form and magnitude of response. In other words, when a response must meet a criterion or standard in order to be reinforced, the process is

called "differential reinforcement." Academic standards are criteria of performance which the pupil must reach before he is reinforced. A teacher might demand oral spelling in which the correct response must consist of spelling *plus* correct pronunciation of the word. All skill building requires differential reinforcement.

In learning to throw a curve ball the reinforcement is immediately evident. If the ball curves properly then grip, wrist movement, arm motion, and ball release will be differentially reinforced because other combinations fail to produce the desired curve. When a person gets the "feel" of tennis, swimming, pitching horseshoes, dancing, typing, or speaking a foreign language he has learned to associate the *way* he performs with success, and he can tell by his own action when he is performing correctly. He knows when he is "right" or "off" by the feedback of his own movements before the objective results become apparent. Learning the "feel" of a skill and self-evaluation through sensory feedback points up differential reinforcement. The teacher can facilitate the operation of differential reinforcement by making as clear as possible the kind of behavior that is deemed successful in a given situation and by informing the pupil immediately as to how close he has come to the criterion. The process known as "good coaching" requires effective management of differential reinforcement.

SUCCESSIVE APPROXIMATIONS

Information should not be presented to the learner in "large chunks." An extreme example is that we would not expect a child to learn chess by telling him the rules, reading off the best plays, and then telling him to go to it. Instead,

we would give him the names of the pieces and reinforce bim for moving the pieces correctly. We would break up the total task into a series of small steps. Each step should be easy and should be reinforced only when properly performed. The result is gradual progress which leaves no embarrassing gaps. Successive approximations is a technique of managing differential reinforcement. The learner is not reinforced for merely repeating steps learned earlier, but for the more complex patterns as he moves toward an adequate command of the game. Thus, the teacher of chess is reinforcing differentially as the learner comes closer and closer to actual chess playing. The learner is reinforced for behavior representing a given level in his progress toward learning the whole task, but he is not reinforced for the same behavior he had already acquired, when he reaches a higher level. Finally, he is reinforced for playing chess, or for displaying adequately tbe end product and not for merely being able to move and name the pieces.

GRADUAL REDUCTION OF CUES (FADING)

The individual does not learn material without some kind of cueing from the environment. As he becomes better acquainted with the content, he becomes more and more able to respond correctly without outside help. A functional analysis of behavior shows that the amount of cueing may be gradually reduced as learning progresses. When the learner has finally achieved the desired proficiency he has reached the stage where cues are no longer necessary. Such is a "natural" way of learning, since it is the way people learn even the simplest of skills. In a strange environment, the person searches about for all cues available in order to under-

stand, that is, to make appropriate responses. With repeated contact, he finds it less and less necessary to make use of detailed elements and requires only general guideposts or outlines (cue points) in order to deal effectively with the situation. Reinforcement psychology suggests that there are *systematic* ways, which may be substituted for "natural" haphazard methods. Cues can be gradually removed from material to be learned so that the pupil can respond eventually in the presence of minimal cues. The systematic, gradual removal of cues in a controlled learning situation is often called "fading" or "vanishing."

STIMULUS DISCRIMINATION

Discrimination is the act of selecting something while rejecting something else. The rate and form of responding may vary in the presence of different stimuli. In the classroom, stimuli are legion. Only certain stimuli are selected by the learner. When selection and response to stimuli are followed by reinforcement, while no reinforcement follows response to other stimuli, then learning is the result of stimulus discrimination. More correctly, such *is* stimulus discrimination. An example of this is when a teacher uses a multiple choice test as an instrument of instruction. Instead of using the test to see how many items can be answered correctly, the teacher presents the test so as to use each item as a basis for discussion. As the discussion proceeds the teacher reinforces pupils who choose correct answers while he does not reinforce wrong answers. When a stimulus or group of stimuli influence the learner toward their selection (or rejection) because of some past experience with those kinds of stimuli then the responses of the learner are said to be un-

der *stimulus control.* Stimulus discrimination is the process that helps the learner become aware of the importance of *differences in the environment,* while differential reinforcement helps him to learn the importance of *how* an act is performed.

FEEDBACK

Learning is change in behavior. In order for a learner to change his responses, he must be furnished with some kind of awareness of their consequences. When the learner is made aware of the consequences of his action, the process is sometimes called "feedback" or "knowledge of results." An example of feedback as a corrective agent is seen in the wobblings of a child learning to ride a bicycle. If he makes a turn to the right while his weight is swinging to the left he begins to fall to the left. He may quickly shift his weight and turn the wheel. If he does not alter his response pattern in that way, he experiences falling. He learns to ride properly after his response patterns have been repeatedly corrected by his "knowledge of consequences."

In education there are various sources of feedback—the teacher, peers, answers in books, and learned standards for self-evaluation. If no feedback is available for response evaluation, the correct response will not be readily learned. Consequences of responding act through feedback to maintain or shape response probabilities.

IMMEDIACY OF FEEDBACK

When feedback occurs long after the response is emitted, learning may show little or no progress. While experimental

results have not been conclusive concerning how immediate feedback should be, there is general agreement that feedback of some kind is necessary for efficient learning. It seems probable that the necessary immediacy of feedback is related to the kind of learning attempted. A "good" learner seems to use input of information in a more efficient way than does the "poor" learner. Original endowment of the learner as well as his previous familiarity with elements which have some similarity to those being learned are important because they seem to determine the amount of cueing and immediacy of feedback required. If a task involving an extended gross effort is simple, then feedback may be delayed until the end of the effort. If several familiar elements are to be synthesized into a single larger unit, feedback may he necessary at each step of the synthesis so that the learner does not "go wrong." Present consensus seems to be that feedback ought to be provided shortly after a response so that the learner will not perpetuate incorrect responding and so that the desired changes will occur efficiently.

While the foregoing discussion is not an exhaustive description of the psychology of reinforcement in the light of a functional analysis of behavior, it should suffice for making operating rules to suit the purpose of our theme. The section to follow presents some generalities which may act as intermediaries between the psychology and its application.

A brief overview of education according to a psychology of functional analysis is appropriate at this time. Functional analysis is a system of relating changes in the learner's environment to changes in his behavior. Since the school environment is strongly social in makeup, functional analysis applied to teaching must emphasize the impact of social stimuli on learning. The teacher, a part of the social environment of each pupil, is seen as an important change agent,

one who can control certain factors so as to influence the achievement of pupils.

The first step by the teacher in using functional analysis is to determine what reinforcers in the school can be easily identified. Some reinforcers are positive, such as confirmation of success, commendations, high grades, and special opportunities given because of outstanding performance. Sometimes the teacher uses negative reinforcement, which is the process of removing aversive stimuli contingent upon some act of the pupil. Examples would include such actions as removing low grades because of demonstrated improvement and removing an imposed restriction when extra work has been done. A comprehensive list of reinforcers in the classroom requires personal knowledge of each pupil, including the things he likes to do, what he tries to avoid, his goals, and the like. When the teacher finds that nothing he can manipulate will influence a given pupil, then he needs help in dealing with that pupil. Let us examine some practical details regarding the use of functional analysis by the teacher.

There are three phases of education implied by functional analysis. They are *adaptation, shaping*, and *maintenance.*

Adaptation. When a pupil enters a new classroom which has a new teacher, along with new texts, peers, and tasks, he is likely to be apprehensive. When much of one's environment suddenly becomes unfamiliar, there is a great likelihood that he will display some emotional behavior. He will probably show mild anxiety, uncertainty, and, in general, heightened emotional activity. As he becomes accustomed to his new environment his emotional activity subsides. Reduction of anxiety and other nonfunctional (nonuseful) emotions is called "adaptation." Our selected psychology suggests that teachers can speed up the adaptive phase. Let us

list some things which teachers often do and which seem worthwhile according to our psychological viewpoint.

Listing the course objectives in specific terms rather than in vague generalities.

Providing a clear description of how the final grade is to be determined.

Giving each pupil an assignment sheet which indicates the amount of content to be covered and the relative importance of each topic.

Providing an overview or orientation of the course to point up the nature of the content, the kinds of work that can be done for extra credit, and outside readings that supplement the text.

We are giving scant description of adaptation here, but we think that the analysis of teaching practices in Part III will supplement the above points. One obvious criticism of the foregoing list is that it implies a highly structured course, which is often regarded as undesirable. We expect later on to point up the psychological importance of structure and to indicate which things need detailed structure as well as those things which are developed or structured by the learner. These considerations are important and exciting but do not belong here.

Shaping. After the pupil has adapted to the new situation the shaping process should begin. Shaping cannot have maximum effect until the learner is relatively free from anxiety, fear, and the like. Again, shaping is the process of bringing about change in behavior. The tools of shaping amount to the techniques of manipulating stimuli which in turn affect the way the learner acts. According to functional analysis shaping is a necessary phase of education because it lumps together all the specific changes which are commonly called "achievement." The educational aim, according to our psychology, is to bring the forces of shaping under the control

of the teacher and the learner. Emphasis is on "deliberate control" rather than on caprice, chance, or accident. The assumption is that human learning can be *engineered* in the sense that conditions can be realized that will produce maximum efficiency when compared with the less controlled means.

One common objection to the emphasis upon control is that it places the learner in the role of a pawn, a passive lump of wax to be molded at the pleasure of a manipulator. That interpretation is incomplete and misleading. It fails to point up the desirable aspect of control. "Control" does not deny "self-control," because the latter is a species of the former. If one takes the view that maturation requires optimal growth of self-control, then the mature learner is one who gradually acquires skill in controlling variables which in turn influence his own behavior. Example: Money is a variable which has considerable influence on most people in our society. But money is not a variable of caprice. It is highly controlled. Those who are in a position to control (earn and manage) money so that enough is always available for their natural and learned needs exhibit the kind of self-control mentioned above. It is *learned*. Many people, however, are controlled by money without having much control over it. Not all effective variables can be controlled by the learner. But he can manage some quite skillfully to his long-run advantage. *To the extent* that he acquires *this* ability he has achieved self-control.

The upshot of assuming that behavior is controlled either deliberately or by caprice is that it sets the stage for engineering desired changes through techniques of control. It is a hopeful determinism because it places the control of some determiners in the hands of the individual, who can thereby achieve a concrete facet of freedom. If behavior is determined by either caprice or deliberate control, then free-

dom can be achieved only through education, that is, by learning how to control one's self. The teacher is the logical person to assume deliberate control in helping the pupil to learn how to control himself. Shaping does not necessarily support exploitation, although it can be used by one human to exploit another. The teacher may be seen as one who teaches the pupil self-control in certain areas of behavior.

Conditions for shaping optimal acquisition of information are given in the next part and therefore will not be listed here. Part III is devoted to developing operating rules for shaping of information getting.

Maintenance. The third phase of education according to functional analysis is the process of strengthening learned behavior so that it will be available when needed. In terms of functional analysis that process is "maintenance." In education the effect of maintenance is seen as retention, application, and transfer of learning.

When a response is reinforced each time it is emitted, it quickly loses its strength (is extinguished) when reinforcement is withheld. The strength of a response can be measured by the number of times it is emitted when not followed by reinforcement. A strong response is one which will endure a rather long time under nonreinforcement. A weak response extinguishes easily.

Resistance to extinction can be engineered by the way in which reinforcement is managed. In general, response strength comes from a gradual reduction in the frequency of reinforcement either on a time basis or on a work basis. When a response is *not* reinforced each time it is emitted, we say that the reinforcement schedule is *intermittent*. Technically, "a response is strengthened to resist extinction by intermittent schedules of reinforcement." There are many combinations of intermittent schedules which we cannot describe here. The main point is that the psychology implies

that a pupil must experience some form of intermittent schedule of reinforcement to bring about sustained retention of subject matter. Let us now list some of the conditions which teachers ought to include in their management to help pupils retain knowledge over a long span of time.

Presentation of material in multiple contexts.

Numerous examples and illustrations of important concepts.

Assignment of tasks which require the use of new material.

Reinforcement available only after the completion of tasks.

Gradual increase in the complexity of tasks or problems.

Practical applications of knowledge demonstrated.

Student assigned task of presenting appropriate demonstrations.

Groups of students given task to find, list, and describe applications not covered in class and in the text.

Critical evaluation sessions of structure, functions, and meanings of content.

Individual and group projects.

The above conditions do not point up the details of optimal management in putting them into practice. Proper application requires a systematic program aimed to develop specific operating rules and to test them under classroom conditions. We hope to carry out such a program, or to describe it, in the case of helping students to acquire information efficiently.

THE PSYCHOLOGICAL MODEL FOR *ACQUISITION OF SUBJECT MATTER*

The model to be described in this section is meant to be used as a basis for helping students acquire the content of a subject matter. It is not primarily for the purpose of mainte-

nance, which includes retention, transfer, and application. Separate models devoted to maintenance are contemplated by the authors for future publication. Part II of the book contains a description of an educational perspective which covers the various steps involved in learning subject matter. After the reader has completed Part II the specific contribution intended by the model described below will be clear.

The model contains eight features that will facilitate the learning process:

1. Objectives to be learned under each topic are clearly presented.
2. The content is presented in relatively small information task units.
3. The information task units are arranged in a sequence to maintain high continuity for the learner.
4. Each unit contains ample cueing to predispose success for dealing with the task presented.
5. A model answer is available to the learner after he has completed each task.
6. The rate of pacing is set by the learner.
7. The learning situation is set up and managed to insure a minimum of distractions for the learner.
8. A review test is presented that makes clear to the learner the specific behaviors necessary to meet the objectives given at the beginning of the topic.

Objectives to be learned under each topic are clearly presented. Human beings have a great advantage over lower animals in learning new tasks. The human is capable of acquiring a complex verbal repertory which he can use in gaining further information and in dealing with nonverbal tasks. All normal students, and even those considerably retarded, enter the school with a background of verbal learning. Since most of the information that makes up subject matters is verbal in nature, the teacher relies heavily upon verbal com-

munication to introduce topics and to present new concepts and facts.

We have indicated before that teaching is a process of influencing behavior in a given direction. The value of presenting the objectives at the beginning of each new topic is rather obvious. According to the psychology selected, the specification of objectives serves to equip the learner with a sample of discriminative stimuli in advance so that the cueing found in the specific tasks can operate to a maximum. In brief, a list of specific objectives provides the student with things to look for later on; it furnishes him with an expectancy so that he can deal effectively with the details. Expectancy is simply that behavior which intervenes between an operant and reinforcement. When expectancy is not characterized by excessive emotional behavior, the person tends to make relevant preparation for tasks ahead.

The objectives should be presented so that they not only indicate the things to be learned but suggest the value or "usefulness" of reaching the goals. It should be clear to the student why he is expected to be successful in dealing with the tasks. The "why" part of the objectives can be accomplished by describing how the information to be learned is related to the successful performance of future tasks in the same course, in later courses, and in everyday experience. Making the goals clear to the learner should function as a stimulus (motivator) for learning the content.

The content is presented in relatively small information task units. The psychological value of this process is to provide the learner with a feeling of *getting somewhere.* It has been pointed out that reinforcement is important in the learning process. When the student is presented with a bit of information and provided with a task that calls for using the information immediately, he is likely to experience a

feeling of satisfaction as a result of success. The information task unit functions as the occasion for successful manipulation of the information bit. When we contrast this approach to the long, rambling discourse found in some books and lectures, we can easily see how the relatively small unit can function to bring about reinforcement.

The second psychological advantage in favor of the information task unit is that it tends to keep the learner active. It not only presents him with relevant tasks frequently, thus keeping him actively engaged, but it also tends to sharpen and maintain his attention because the tasks are small enough to fit within his span of apprehension. Consequently, he is less apt to wander off the track through inattention and daydreaming than in the situation that presents him with long and confusing descriptions heavily loaded with things to keep in mind as he proceeds. The learner must remember the important points previously covered, but he does this best when he has the opportunity to make relevant use of the points as he goes along. Students who have already acquired peak skill in learning seem to break the monotony of long discourses by reciting to themselves, making up questions, and answering them as they go along. But the average learner has not acquired such skill and often is unable to retain prior information to help him deal with later content. When material is structured in relatively small information task units, it should help the learner acquire the kind of learning habits which will be useful for dealing with more difficult material. Therefore, it is believed that not *all* material need be structured according to the present rule. Yet, the rule seems to be particularly valuable in the early stages of a new course. Some students may need to experience this kind of structure longer than others. But the long-range plan is to gradually lengthen the information task units until the stu-

dent can function efficiently with the more conventional mode of presentation.

The information task units are arranged in a sequence to maintain high continuity for the learner. Research has shown that it is more difficult to learn a series of disconnected words than to learn words that form meaningful sentences. Also, it is more difficult to learn a list of nonsense syllables than a list of common words. Continuity is found in the connecting links between information bits. Common terms and meanings that overlap between adjacent information task units maintain continuity through a kind of redundancy, which performs the valuable function of providing something familiar to which the new is attached. The tasks in a chain of units often require highly correlated responses. They are correlated in the sense that any given success predisposes success with the next task. Thus, redundancy and correlated tasks are deliberately built into the sequence of information units to insure continuity. Psychologically, we speak of cueing that is similar between correlated tasks as the controlled variable which helps to establish a meaningful flow of content. In general, relational terms plus connective phrases make up the tissue of continuity. The result quite often is a longer discourse than the more elegant message having only the bare necessities. But continuity promotes learning and helps the learner keep in mind information that is important for understanding later passages. By contrasting the two following examples, the point becomes abundantly clear.

a. Reinforcement is important in learning. Teachers ought to provide for resistance to extinction. They should also encourage frustration tolerance.

b. Reinforcement is a process that refers to the strengthening of a learned response. It is brought about by helping the student experience success by making tasks relatively easy and by giving the

learner feedback that confirms his success. When the conditions for learning predispose success, the student is apt to retain the information. Thus, retention depends upon reinforcement. When retention has been acquired we say that the responses resist extinction. A related habit that can be learned is frustration tolerance, which is the tendency to keep trying even when expected successes are not experienced. The way to build up frustration tolerance is to gradually decrease the number of reinforcements in relation to the amount of work accomplished. Thus, by gradually shifting the schedule of reinforcement so that more work is done between consecutive reinforcements, the learner acquires perseverance or the tendency to keep trying when success is only intermittent.

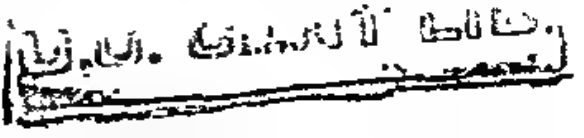
Example (a) lacks continuity for the learner who is unfamiliar with the terms being discussed. It may function satisfactorily as a summary but not for initial learning. The second example is much longer and redundancy is obvious. But the redundancy provides a means for tying the concepts together so that the learner can grasp how they are related. Although the examples are not structured as information task units, they illustrate the role of redundancy in establishing continuity. Prime examples of information task units can be found in programmed materials, which will be covered in a later chapter.

Each unit contains ample cueing to predispose success for dealing with the task presented. Our psychology suggests that the getting of information should not be difficult for the student. Challenge should come at a later point such as in the application and analysis phases. There is no need for making the grasp of information recondite. If the teacher deliberately makes the learning of content difficult, he is slowing up the process for brighter students and conditioning failure in the less intelligent ones. Therefore, skill in providing cues to help the student grasp new meanings and facts is important for efficient instruction.

A model answer is available to the learner after he has completed each task. The emphasis is upon the *availability* of the correct answer. Some pupils have need for more information than others in order to grasp meanings. Also, some students need to be reminded more often than others where they are headed. Some learners need reassurance, although they may be almost certain of the correctness of their efforts. Knowledge of results serves a valuable function and should be available when the learner calls for it. He can be counted upon to use it to the extent necessary. The feedback should also be immediate in most situations.

Feedback should be sufficiently detailed so that the student can evaluate his response effectively. Without some reference point in the form of feedback, the learner cannot acquire a sound means for self-evaluation. As the learner grows in confidence, he can develop techniques for self-evaluation with minimum dependence on outside stimuli. Therefore, to promote good self-evaluation the student must be provided with knowledge of his efforts. By gradually diminishing the amount of feedback as the student gains confidence, he acquires knowledge of the criteria to judge himself as he progresses. Consequently, by emphasizing the *availability* of feedback rather than the forced presentation of it, the student chooses for himself the time and place he deems it necessary.

The rate of pacing is set by the learner. Different students attend to and assimilate differing amounts of information. Some kind of arrangement needs to be made which permits the rate of stimulus contact with the individual to be controlled. Control may be either random or systematic. It is not easy for the teacher to know which rate of flow is best for each student. No set pattern of flow such as found in moving pictures and sound tapes is necessarily best for all learners.



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The remaining alternative is control by the learner himself. The student needs to be able, in effect, to say to the world of stimuli, "Hold on a minute, I can't keep up with all of you at once!" Here is a point at which the learner initiates behavior or emits operants. If the rate of presenting material is too fast then the student gets lost and will tend to become confused and discouraged. If the rate is too slow he will probably become bored. Therefore, the solution seems to be that the rate of flow should be controlled by the student. Should the rule of self-pacing always be applied in teaching? We think that it should not *always* be used because it is often desirable to help the student speed up his pacing. Slow readers, for example, may continue their slow pace unless something happens to influence them to increase it. When increased pacing becomes a desirable goal, the teacher should be ready to place the student under conditions that will reinforce the gradual increase in pacing. Many situations in everyday life require the learner to keep pace with externally controlled rates as exemplified by television, movies, public speeches, and to some extent, group discussions. We believe, however, that self-pacing is an important condition in the shaping of behavior during the initial stages of learning. When the student acquires the fundamentals of a skill, or a body of knowledge, some provision should be made to give him practice in keeping up with externally controlled rates.

The learning situation is set up and managed to insure a minimum of distractions for the learner. If there are competing interests, interfering stimuli, or intrusions upon the learning situation, they may produce a clutter which will thwart our well-laid plans. All psychologists recognize the bad effects of distractions on learning efficiency. Learning sometimes occurs despite distractions; but there is nothing that indicates distractions are a boon. Fatigue seems to set in

earlier under distraction than under situations which are rather free of such stimuli. Psychologically, the problem is twofold: First, to arrange conditions so that minimum distractions occur, and secondly, to encourage selective attention to stimuli—operant discrimination. Some specific suggestions on how to realize this and other conditions for optimal information getting will be developed in Part III.

A review test is presented that reminds the learner of the specific behaviors necessary to meet the objectives given at the beginning of the topic. When a topic is completed the student should be given a means to make it clear to him just how well he has progressed in acquiring the essential knowledge. Just before the topic test is presented to him a summary of the important points should be indicated so that he can see how his knowledge should be organized. The summary should be followed by a test. After completing the test, a set of model answers should be available so that the student can assess his achievement.

It should be remembered that the above conditions were chosen on two bases: Compatibility with our selected psychology and on the basis that the condition can be manipulated by the teacher. We do not claim that the conditions are exhaustive. We do claim that the listed points are representative of the things that ought to be found in an efficient teaching situation devoted to acquiring information.

Before the above model is used to analyze common teaching media such as the lecture, discussion, field trips, and the like, Part II is presented to provide a detailed perspective of education that is intended to describe the conception of education in which the model can operate appropriately.

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PART TWO

CHAPTER 6

A Perspective of Education in Subject Matter: The Information-Getting Phase

THIS CHAPTER deals with one of the four stages of education to which we have referred several times. Again, they are: information getting, application, analysis, and creativity. These four phases of learning can serve as the basis for a broad research operation which can be carried on mostly in the classroom. The teacher can be the central figure in testing the operating rules.

Table 1 shows the skeleton of our perspective.

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TABLE 1

Phases of Education in Subject Matter

	INFORMATION GETTING	APPLICATION	ANALYSIS	CREATIVITY
Criteria of Success				
Teaching Functions				
Instrumental Behavior				
Personality Traits				

Column headings identify the four phases of education. Along the left side are the things that must be done to make the four phases useful. We need to find a way to make the phases stand for things that occur in the classroom. We must also establish ways of measuring success in each phase and show what teaching functions are effective in producing success. It is also important that we be able to describe those actions of the learner which represent progress toward each stage's goals. Finally, we need to be able to determine individual differences among learners in each pbase.

If we can accomplish those aims noted above, then we shall have an *experimental* definition of education in subject matter. Under an experimental definition, a term is related to definite contexts, so that factors controlled and ways of controlling them can be clearly related to results found. Operating rules are testable statements which are ohtained by comparing an actual teaching situation with the psychological model. Differences between model and teaching

situations may be used to describe how real situations ought to be changed.

So that this book may become a "practical tool" for the teacher, let us now follow an example of the use of Table 1 as a plan of application. A list of tasks will first be given, to show how the phases of learning are connected with the things that must be done to make the phases useful.

TASKS SHOWING HOW THE FOUR PHASES ARE HANDLED

a. *Establish a Tentative Definition of the Learning Phases.* We must begin with an arbitrary statement and then modify it to fit the experimental facts. For example, it is necessary to have some notion of the meaning of "information getting" so that we may arrange the details necessary for studying it. The experimental definition will emerge from the set of simple interlocking studies carried on in the classroom.

b. *Describe a Method for Measuring Success in Each Learning Phase.* This comes under "Criteria of Success" in the figure, and it makes contact with "information getting" plus each of the other phases by stating clearly how success is to be evaluated or determined.

c. *Specify the Controlled Conditions Used to Stimulate the Learner to Reach Success.* This means to list the teaching function in the form of the ideal conditions which have been taken from the psychology. We aim to use a *pattern* of conditions which is supposed to center on *manipulable* variables which make the *ideal learning situation.* The variables must be manipulable so that we can determine the teacher's most efficient role in managing the classroom when given a particular set of goals.

The proposed experiments in the classroom differ from those carried out in the laboratory in that the classroom research is aimed at finding an arrangement of variables (highly complex clusters) which contribute toward increasing efficiency of teaching and learning. Laboratory experiments, on the other hand, may be characterized by premature attempts to develop theories of wider scope than is warranted by the kinds of situations studied. One of the reasons for our borrowing the Skinnerian viewpoint is that his "system" is not made overly complex by too many explanatory concepts. Emphasis is upon the data and "explanations" are not dwelt upon. "Explanations" presume causes, but terms which stand for actual phenomena should be easier to apply to related situations than are terms which stand for presumed causes.

In this kind of experimentation, precision is sacrificed, but gains are sought which will be so large that a painstaking statistical analysis will be unnecessary. Unless the effect of changes in teaching are large enough to be obvious by inspection, the gain in adopting new methods will hardly equal the cost. Large gains may also be minutely analyzed, whenever this is desirable, of course.

d. *Describe the Kinds of Behavior Exhibited by the Learner in Advancing Toward the Goal.* The table shows this as "instrumental behavior." Instead of using two methods of instruction and comparing the results of their effects on learning by a posttest, we want to get a record of the process itself. We want an ongoing or accumulative record so that we can compare teaching functions at any given time with the way the learner is behaving at that time. We shall not use complex gadgetry in getting accumulative records, since elaborate instruments are usually not available to teachers. The job calls for ingenuity and creativity and stands as one of the

tougher challenges to classroom research. However, we shall illustrate some successful instances of this research, in Part III.

e. *Measure the Individual Differences of the Learners at the Beginning of the Experiment.* In the figure we use the term *personality traits* to stand for those things which the learner carries into the situation. Differences reduce to two things: The amount of information which the pupil already has, which is related to the new material; and his personality pattern which is logically related to the learning tasks. Here, some concession has been made to personality psychology. Yet traits are not seen as *causes* of achievement differences, but rather as *correlates* which add diagnostic information that may be valuable in deciding how the teaching situation can be improved.

INFORMATION GETTING

We define information getting as *a kind of interaction with a body of content containing new knowledge to the learner and resulting in retention of some or all of the new knowledge.* The definition acknowledges activity on the part of the learner, leaving room for instrumental manipulation by the learner. Our aim is to sharpen the definition through an experimental program so that the operations of measurement and control used in the experiments will provide specific referents of the term *information getting.* We believe that the best way to develop standard meanings of many key terms is by experimental definitions rather than by armchair defining.

Criteria of Success. How must the learner behave in order to be successful in getting information? The two convenient

measures of information getting are measures of "recognition" and "recall." Ability to discriminate between valid samples of the content and expressions not consistent with the learned material is called "recognition." Objective type tests measure recognition. Recall may be measured by the essay test or the oral examination. The learner must reproduce samples of verbal behavior that approximate the content to be learned, in "recall."

Teaching Functions. A teaching function is a form of stimulation that influences the learner to alter his behavior in a desired direction. In Chapter 5 we developed a set of ideal conditions which we called a "model." We shall use this model as the basis for teaching information efficiently. The model is reproduced below:

Low ratio of unfamiliar to familiar terms.
Content divided into small parts.
Each part has a bit of information plus a task for the learner.
Cueing in each part is strong enough to keep failure at a low level.
Cueing for a given response is progressively reduced.
A model response is made available after each task is completed.
The learner is stimulated to use criteria to evaluate his own progress.
Flow of material is controlled by the learner.
Distracting stimuli are minimized.

In Part III we are to use the model as a basis for analyzing some typical forms of teaching (lecture, discussion, field trip, and films).

Instrumental Behavior. The problem here is to discover how the learner manipulates the content when he intends to succeed in acquiring information. The main difficulty centers on the fact that the processing of information by a learner when he reads or listens is not directly observable.

How can we get at the *process* of learning information when such things as reading and listening contain so many activities which cannot be observed (without special laboratory equipment)? We must make as much of the behavior as possible *overt. If we are to study reading, we choose* oral reading, not silent reading. This would be recorded on tape and then analyzed. Then such controllable variables as ratio of unfamiliar to familiar words, size of information units, and so on, could be studied. The general plan is first to identify the overt counterparts of implicit forms of learning, then insert experimental conditions, and measure the results of an accumulative record.

Personality Traits. The psychology of functional analysis does not interpret personality traits as determiners of behavior. Perhaps the most useful definition is one which regards traits as measurable habits which persist over strong changes in the environment. They can be measured, but not with precision. However, they can be used to describe an individual as well as to predict how he will act relative to others.

If it is found that phases of learning call for differences in patterns of traits, and these differences are sharp, then what kind of decisions must be made in teaching? What personality traits are likely to be found in the person who succeeds best in getting information? We must begin to answer the question with reasonable guesses. Let us list a pattern of traits which may be related:

High	*Low*
docility	independence
suggestibility	*flexibility*
industriousness	theory-oriented
need for achievement	aggressiveness
trusting	doubtfulness

Other traits could be added to the list. Those listed are not "standard" personality dimensions. Yet there are measures that approximate the dimensions listed above.

We have now completed an overview of the information getting phase of our perspective. The purpose of Part III is to elaborate on how the psychological model can be used to develop the information getting portion of the schema shown in Figure 2. The remaining chapters of Part II will be given to overviews of the application, analysis, and creativity phases.

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CHAPTER 7

A Perspective of Education in Subject Matter: The Application Phase

We shall now examine the application phase in much the same way as we looked at information getting in the preceding chapter. However, the treatment of application will be more extensive than was that of information getting, since application, analysis, and creativity are not to be discussed in Part III.

The phases of learning which we are describing have an apparent artificiality, largely because the pupil is not seen as moving through stage after stage in a neat, orderly fashion. Under this systematic viewpoint, we must expect the learner to be moving back and forth freely from one phase to another without observing any stringent rules or boundary lines. For example, it is not necessary that the pupil get *all* the available information before he goes into the other phases. It is meaningful, however, to think of the pupil as

being influenced to move toward creativity rather than being encouraged to remain in the information stage. There is the possibility that learning subject matter is largely an integrative function, that the pupil combines his many acts into a complex pattern and that the lines between the phases we have named are quite arbitrarily drawn.

Science is often concerned with arbitrary classifications, which are actually convenient abstractions. Such classification is sustained by the hope that the results will justify the effort. Likewise, we hope the schema presented in the preceding chapter will be justified by the kinds of questions and problems that ensue and by the results obtained from pursuing the answers.

Content of a course may be thought of as a body of knowledge which can be communicated more or less successfully under conditions of ordinary teaching. Ability to recall and to recognize important parts of content has been taken as evidence for success in acquiring the knowledge. Before deciding upon those criteria of success to be used in judging the application of knowledge let us describe the process of "application" itself.

To apply knowledge of a course means to use it instrumentally in situations *outside* the subject matter. A child applies his knowledge of arithmetic when he makes correct change, when he measures the height of his brother accurately, and when he calculates the cost of a motor trip. Education ought to encompass more than a study of the subject matter itself. The word *instrumental* suggests that education is not merely a process of knowledge getting but that it includes the making of useful connections with other areas.

Special provisions ought to be made to help pupils use knowledge in a variety of ways. There is a need to break

down the artificial and tight compartments known as "subject matter." If this is done, then boundaries between areas of knowledge may be regarded only as conveniences in communication rather than as something that actually exists.

CRITERIA OF SUCCESS

What behavior shown by the child may be accepted as indicative of successful application? The obvious answer is that a child successfully applies when he solves a valid sample of problems *outside* the subject matter area by using information learned *within* the subject. A more difficult side of the question is met when we try to describe how the teacher can determine which problems are appropriate and the extent of the sample of problems.

Let us first clear up a possible source of confusion. Our reference to "subject matter" is not the same as to a "course of study." A course of study is not confined to knowledge of the subject matter. Arithmetic is a subject matter. But a course in arithmetic should extend beyond the formal boundaries of the subject matter. When the teacher brings in practical problems to be solved he is staying within the course but has gone outside pure knowledge of arithmetic.

The idea of application, as we are to use it, suggests that a course of study is a slice of the pupil's life in which he becomes familiar with new knowledge and learns to manipulate it. This manipulation includes sizing up situations, making decisions, and successfully following up those decisions with action. "Sizing up a situation" is comparable with the phase called "analysis." Making and carrying out decisions approximate our notion of "application."

A course of study should add to the pupil's freedom and

sense of power. Without freedom to deal with things one cannot be creative. Education should therefore be engineered so that experience in acquiring and manipulating knowledge extends from highly structured situations to those determined by the learner. Progress toward self-determination should be gradual, however. As the pupil matures in his skill at learning he should be given increased freedom to decide upon his own courses of action.

A successful level of application has been achieved by a pupil when he can demonstrate appropriate manipulation of parts of a subject matter in situations external to that subject. Subject matter parts should be chosen by the teacher and should adequately sample the applicable content. External situations and problems should be well sampled as to area and difficulty. This means that problems should range from easy to difficult and should be found in the typical areas of application.

TEACHING FUNCTIONS

It must be emphasized that our perspective does not leave application to chance. Application is not a process that is assumed to occur merely because the pupil has acquired knowledge. This highly important phase of teaching calls for special tools and experiences that are best suited to reach the criterion. If the teacher does a good job in helping pupils to use knowledge, then the transfer of learning will not be left to chance because transfer *is* application in new situations.

Application can be expected at all levels of learning as well as in many areas. Reading, writing, spelling, and arithmetic lend themselves to application. In reading, the child

learns word recognition, order of words, punctuation, phrases, clauses, and phonics. When he is able to transfer classroom reading skill to outside material he is demonstrating application because he is using his knowledge to solve the problem of understanding what, to him, is a novel communication.

The question about low utility of some kinds of knowledge is not easily answered. Research suggests that transfer is not so much a function of subject matter as it is of the way the learner experiences the content. It cannot be said that all knowledge has equal application value in our culture. For this reason, it is important that teachers acquire broad general backgrounds so that many relations with other areas are known, along with extensive and intensive training in their subject specialties.

Application is a maintenance process and it calls for intermittent schedules of reinforcement. This kind of schedule, along with the technique of successive approximations, provides most of the raw materials for describing a set of conditions for optimal application. Efficient control of reinforcers is finally resolved into two techniques of management: (1) Selecting a task which the learner can perform, so that feedback can be given for success, and (2) making the reinforcement contingent upon an adequate performance. Some applications of concepts require long and involved work. How can the teacher help the student reach the complicated levels of application? The general answer is that this may be accomplished via a gradual increase in task complexity. The pupil is provided with a bridge between what he knows and its use in a variety of situations. Many school experiences designed to further application are weak at this point, since important steps are omitted, and the pupil gets lost.

The great advantage that shop instruction has over ordinary classroom teaching lies in its facilities for helping the learner to see and do each step in the process of putting abstractions into action. It is wrong to regard the shop as a peripheral part of the school. Actually, the shop has an overwhelming advantage over the average academic classroom. Subject matter in academic courses is largely verbal. Application involves both verbal and nonverbal situations. We have scant basis for assuming that verbal learning will automatically transfer to nonverbal activities. On the other hand, the shop provides: (a) specific functions assigned to devices to be used—ambiguity is minimized; (b) each device can be easily controlled, thus providing reinforcement for its operator; (c) feedback is frequent or even continuous; (d) instructional language used for teaching control of devices is precise, compared with some instruction in academic courses; (e) since shop requires multiple sensory experiences—seeing, hearing, feeling, and sometimes smelling and tasting—differential feedback can be cross-checked. More of the learner becomes involved than under restricted feedback; (f) shop devices usually require a clearly ordered set of responses that lead to success; (g) tangible reinforcers (lamps, tables, and so on) result from the learner's efforts, and so the schedule of reinforcement is intermittent; (h) the range of reinforcers available becomes visibly greater as skill increases; and (i) learners are reinforced for being productive —they learn that being producers is as satisfying as being consumers.

Perhaps the main significance in the above is that academic teachers might find it worth while to visit the shop to discover how learning takes place efficiently. It is a challenging task to try to approximate shop conditions in a classroom.

INSTRUMENTAL BEHAVIOR

How does the learner manipulate knowledge in order to apply it? What kinds of response classes make up his instrumental acts?

Teaching is a means for expediting desirable ways of acting. Teaching is therefore instrumental; it mediates between a lack of knowledge and skill and the goals of learning. Instrumental acts of the teacher stimulate instrumental behavior by the learner. Psychology has not yet established clear categories of mediate action, but we can at least hope to show what is to be done in order to describe the desired instrumental behavior.

To determine how the learner manipulates content so as to apply it we can begin with the processes of instruction. The general notion is that to make reliable descriptions in psychology the thing to be described ought to be observable. For example, the physicist has certain material tools which permit observations to be made directly. But he can also describe much that is not directly observable, simply because he can set up the conditions needed for testing the implications of his theory. He has both the physical and conceptual tools to test his predictions. When psychologists try to make descriptions of processes not directly observed, or based on theory, they often lack the tools needed to measure the implications. (There are techniques, such as use of projective tests, for making descriptions indirectly, which have utility in areas other than education.) Direct means for bringing the mediate action of the pupil into the open—making it observable—are needed.

We cannot observe all kinds of problem solving. This makes it necessary that we engineer problems so that some aspects of the instrumental behavior will be observable. One way of doing this is to require the student to *record* his attempts at problem solving. For example, instead of merely asking the student to find the answer to a problem, ask him to write down all his work and to give a reason for each step in the calculations. These added directions call for identification of the grounds that support the manipulations. Those students who may get a correct answer but who still do not have the knowledge necessary for supporting their work may be readily identified and helped by this procedure.

We have emphasized the importance of observable, instrumental acts because they provide valuable feedback to the teacher (and to the student) for improving instruction. This is compatible with our chosen psychology, since a *functional analysis* of behavior is principally the process of finding the changes in conditions that predispose specific changes in behavior.

The steps in a functional analysis may be summarized as follows:

a. Define the operant class. In this step, the portion of behavior which changes the environment is described. We make such a description when we note that the rat in the experimental laboratory *presses the bar* in order to get food reinforcers. We are also defining an operant class when we say that the child *spells* cat *in the presence of the teacher.* (To spell *cat* may not result in much environmental change, but when it is spelled in the presence of the teacher it is then likely to have some observable effect.)

b. Describe the feedback event. In the case of the rat's pressing the bar, feedback is in the form of the food pellet which comes about as a result of moving the bar, which in

turn activates the food magazine. Feedback in the case of the spelling example would be the response of the teacher, who may say, "That is fine."

c. Arrange the setting through key controls. In general, this phase of analysis bas to do with describing the things in the learning environment and their arrangement at the time the learner enters the scene. In the case of the rat, the important control is depriving the rat of food for about one day before he begins his learning session. A second important operation is putting the rat into the experimental box ("Skinner box") so that it has the opportunity to emit the behavior "bar pressing," which is the response under study. Thus, a functional analysis must describe bow the learning situation was set up to predispose operant behavior.

d. Describe the changes that occur in the operant class. If the operant increases in frequency, then we say that it bas gained in strength. We mean that the operant is more likely to occur under similar conditions tban if no conditioning session had taken place.

Functional analysis is a psychology of instrumental behavior. This is the reason why functional analysis *is closely* related to teaching, for teaching is a category of instrumental action.

Now we can summarize points which the teacher may use as a guide for planning and promoting the behavior called "application." (The points are not specific operating *rules* since we have not developed a model for application, as we did for the "information getting" phase.)

a. Specify the problems and activities which require the application of information. The teacher should identify areas in which course content can be used, by sampling—he cannot expect to exhaust all possibilities, of course. There are numerous situations to which the pupil can apply his learn-

ing in the basic skills such as reading, writing, and arithmetic. The teacher will have a more difficult task facing him when he searches for instances of application in the case of history, literature, economics, mythology, philosophy, and other liberal arts courses. Yet the challenge will not be too great for the teacher who wishes to make a course a coherent part of education.

b. The final act ("consummatory response") should be so defined that the pupil in a problem situation is to carry out a clearly described behavior. Application responses expected of pupils ought to be itemized by the teacher. When this has been done, achievement evaluation is simply a matter of selecting a good sample of application tasks for the student to carry out.

c. The application task must be set up so that it requires observable action.

d. The record of instrumental behavior ought to be accumulative, if possible. It should be possible to trace the learner's behavior from the presentation of the task to his last response in the chain of responses.

PERSONALITY TRAITS

What traits or persistent habits of the learner are found in the successful user of information? Since no definitive relationship between traits and ability to apply information has yet been shown, we may make only hypotheses. We predict, on tenuous grounds, that high and low measures of the following traits will be typical of the person who shows outstanding skill in application:

High	*Low*
flexibility	rigidity
objectivity	gregariousness
stability	compulsiveness
independence	compliance
general activity	
curiosity	

It is easy to find measures that supposedly measure the above traits, but difficult to show that the tests are reliable and valid. Each trait probably should be defined in terms of observable non-paper-and-pencil behavior, rather than by paper-and-pencil tests only. Direct observation of trait behavior is not common because of high incidence of error in judging complex events quantitatively via the efforts of a human observer. Techniques are needed for recording complex behaviors from which measures of certain events can be tabulated automatically.

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CHAPTER 8

A Perspective of Education in Subject Matter: The Analysis Phase

THE THIRD large phase of education in subject matter, analysis, includes a variety of related processes.

Students should acquire skill in manipulating subject matter critically to show that they grasp its nature, structure, functions, and limitations. Skill in analysis should be an important requisite in scholarship. Such skill stimulates a feeling of mastery or control over an area of knowledge. It tends to prevent the student's learning from weighing heavily upon him. Thus, he should be helped in passing through the stage of sophistry to wisdom, with the latter manifest in control *over* subject matter instead of in control *by* subject matter.

Analysis is essentially critical evaluation by using knowledge as a tool. The tool is used to sharpen discriminations and to point up valid generalizations. It is also employed to

recognize untenable claims and inconsistencies. Analysis implements the quest for meaning. It can, however, be used to excess and can become a stage of fixation for those fearful of risking creative expression. When properly balanced with application and creative manipulation, analysis becomes a valuable aspect of education.

If *application* is the process of using knowledge as a tool for solving problems *external* to that knowledge, then *analysis* of the subject matter is the *internal* side of problem solving.

Some subject matters exist largely as metalanguages, that is, languages within languages. Grammar is a good example. It is used to analyze sentences according to certain rules. Other areas which have heavy analytic value include logic, mathematics, semantics, pragmatics, phonetics, phonemics, and dialectics. Of these, logic can be used to analyze some parts of all subject fields.

Can analysis be accomplished regardless of how elementary the course may be? Can the child learn to make worthwhile analyses in first grade reading? The answer to these questions is "yes." If phonics is taught along with reading, then the child gets an analytic tool which allows him to vocalize new words. This is a case in which analysis and application tend to merge (though they do not always do so). In general, the solutions to problems of analysis are helpful to application tasks as they have been defined herein.

The psychological value of stressing analysis in teaching is that it provides the learner with a means for evaluating his own efforts. Skill in analysis helps the learner to achieve a measure of independence, and it promotes maturation in learning skill. To be able to produce a reliable standard for judging one's own progress is reinforcing in itself. Our perspective has stressed the value of growth in student inde-

pendence from external agents, gadgets, and other aids. The analytic phase promises to implement that goal.

CRITERIA OF SUCCESS

What must the pupil do to exhibit success in analysis? What kinds of measures should the teacher use to evaluate progress in analytic skill? The answer to these questions assumes the same pattern that has been used previously. The first task in teaching is to clarify the *specific* acts which the learner is supposed to perform. A good blueprint for almost any course should leave room for analytic experiences. The amount that analysis is to be stressed should be decided by the teacher.

Some courses are largely studied for their information getting value. Anatomy is sometimes taught almost entirely as a memory course; the aim is to memorize the names and functions of parts within a system. Teachers should ask themselves how much analysis ought to be stressed. The question may stimulate them to redefine their objectives and therefore to alter the teaching functions and criteria of measurement. Perhaps the following questions will be helpful as a short check list for deciding the extent to which analytic behavior should be stimulated:

How far should the pupil go in learning to make judgments of strengths and weaknesses in a subject matter?

How much should the pupil know about the nature of a subject matter—structure, functions, and limitations?

Is critical thinking desirable within the subject matter? If so, precisely what things should the pupil learn to criticize?

Should the pupil be concerned with the semantics of the subject matter? If so, what concepts should be involved?

The ratio of analytic to total experiences making up the course is the proportion of items needed to measure achievement in analysis.

Teaching Functions. What can the teacher do to stimulate desirable analysis? To answer the question thoroughly requires an experimental program. Our present purpose is only to suggest how that program may be conceived.

A teaching function is a stimulus function. A stimulus function is a relationship between a stimulus and a response class. Examples: reinforcement, punishment, operant conditioning, elicitation. Teaching deals with effective ways of managing stimulation. There is no other way by which a teacher can influence the pupil. The important question is this: Does the teacher do anything distinctive to stimulate analytic behavior? Is it possible to specify things that the teacher does to promote analysis that are different from what he does in stimulating information getting or application? The answer to both questions is "yes."

Teaching functions should be different in the analytic phase than in each of the other phases mainly because pupil behavior is different from one phase to the next. Since the criteria of success are different between phases, then the responses that indicate success must differ. The specific things that the teacher does to stimulate analysis are implied by the behavior which the learner must show to reach the criteria of success. Again, we see the importance of a clear description of the goal responses.

We shall examine some of the classes of analytic behavior and point up the kind of teaching functions that seem appropriate for each class.

Clarification is one outcome of analysis. What must be done to clarify something? A thing which might be clear to

the teacher is not necessarily clear to the pupil. The pupil must provide cues so that others may know that something is clear to him. One convincing test is to have him state a concept in his own words and to describe one of his experiences in which the term could be appropriately used. If the pupil is unable to paraphrase a concept, then this is a signal for the teacher to provide him with cues. The strategy is simply to set up a group of questions, supply cues so that he can answer them, and thereby lead the pupil by successive approximations to an acceptable paraphrasing. Probe the pupil to describe his experiences that relate significantly to the concept. He may need help in the form of an example. A concept, then, is clear to the student when he can do two things: state it in his own words and identify situations to which the concept has some appropriate connection. Clarification is a function which overlaps both information getting and analysis.

Classification is another aspect of analysis which implies certain teaching functions. A pupil can classify correctly when he is able to sort specimens according to their proper categories and when he can give the grounds for his decisions. Things that belong to the same class have something in common. The common aspect may be either a single quality or a set of features. The pupil should be helped to identify the common qualities that justify grouping things that have obviously different features. For example, the class of all tools that can be used as levers would contain many specific items of many shapes, sizes, lengths, colors, and the like.

Pupils at all levels can classify. Very young children can make simple abstractions on such bases as color, shape, height, and size. They may also make groupings on a number

of other bases, especially certain everyday functions such as eating, sleeping, crying, walking, and laughing. Teaching functions to stimulate classification would probably include the following:

Present multiple instances of a given class.

Provide practice tasks in sorting, followed by immediate feedback.

Gradually increase the number of critical qualities that define a class.

Encourage the pupil to *name* the class and then provide him with proper feedback when he responds.

When the pupil can sort specimens correctly and can name the class correctly, he has demonstrated ability to classify. When he can articulate the reasons for the correct sorting, he has demonstrated verbally the sources of stimulus control for his sorting behavior.

Interpretation is an outcome of analysis that indicates how well the pupil can connect a learning experience verbally to other identifiable things. If the pupil can describe the consequences that follow from knowledge of a concept, he has interpreted it. Interpretation is *not* giving dictionary meanings of terms. Interpretation must have a context so that a concept within some setting can be examined in the light of its implications. To interpret data is to do one or both of the following: to describe probable consequences based on knowledge of similar events in the past; to describe that which some theory states should follow from the data.

The teaching functions which promote interpretation follow the same strategy as given before. One possible sequence of effective teaching functions may approximate the following:

Begin with something that it is assumed the pupil can interpret. This is usually a principle, concept, or a set of data.

Provide a context different from the one given in the introduction to the concept. If context is unchanged, students may merely recall the interpretation provided by the text.

Test students to see whether they can identify the concept in the new context.

Ask students to describe probable consequences, based on their knowledge of the concept. Successive approximations may be needed —strong cues are given to help the pupil make his first interpretation, with decreasing cueing in succeeding cases. Then the pupil is to be reinforced each time he has been correct for several responses, followed by gradual tapering off in reinforcement.

Ask pupils to make further interpretations and to give reasons for thinking that they are correct. Strongly reinforce them for adequate interpretations, and help those who give inadequate responses by returning to the point just before they made their errors. Use successive approximations to get over difficult hurdles.

Evaluation is perhaps the logical end of analysis. It is a judgment made on the basis of definite criteria and tends to place what is being evaluated somewhere in a hierarchy. Teaching functions should aim at helping the pupil express evaluations which are based on relevant knowledge and on acceptable criteria. It is important to teach for evaluation only when *clarification*, *classification*, and *interpretation* have been adequately expressed. It should he remembered that *classification* is found in all subject matter from the most elementary to the most complex. Children who learn the alphahet, for example, acquire the skill of sorting the letters according to their names. Grammar, arithmetic, history, literature, physics, and the entire range of courses are filled with special terms that call for classification behavior.

Some relevant points on teaching functions which should aid in evaluation are:

Teaching of evaluation should be done only when the pupil has shown that he has satisfactorily carried out the other operations in analysis.

A clear set of criteria on which judgments are to be based should be provided. The pupil will provide his own criteria as he grows in skill. When he has done so, he should be asked to make clear the bases for his judgments.

The key quality in each criterion should be isolated in order to help the pupil grasp the essential part of the criterion. Example: Democracy may be set up as a criterion for judging effectiveness of organizations. The key qualities of democracy may be isolated as shared respect and shared power.

Explanation should be made as to how the key quality can be located in whatever is under evaluation. In the case of weight as an important quality, this would amount to weighing the object.

Practice should be provided, to help pupils acquire sufficient skill in using each criterion. Successful efforts should be reinforced. When failures are noted, the teacher should return to simpler exercises, working up gradually to the more difficult.

Specimens should be provided which can be evaluated by a given set of criteria.

The complexity of things evaluated should be gradually increased. It should be demonstrated that even though what is being evaluated remains the same, completely different decisions may be made if different criteria are used in evaluating.

These suggestions may require more time than the teacher can afford. If so, teaching machines and programs, along with movies and slides, may be used effectively. The suggestions have been given mainly as points to consider rather than to be taken at face value. The treatment of analysis suggests a beginning for an experimental approach—it does

not pretend to provide ideal answers. If analytic skill is accepted as a desirable goal of education, an approach to the study of analysis in the classroom is needed.

INSTRUMENTAL BEHAVIOR

How is analytic skill acquired? Instrumental action by the pupil is stimulated to a large extent by the teacher. The teacher's problem is to select, arrange, and present tasks to the pupil so that this instrumental action can be observed. It is a problem of management rather than one of making (premature) judgments of pupil capacities.

The teacher is a key figure in promoting pupil achievement. This viewpoint does not imply that pupil failure is due to certain pupil traits. However, low motivation, insufficient I.Q., low special aptitudes, or emotional stress are often blamed when pupils do not achieve at specified levels. When this assignment of blame is accepted, then it may be assumed that there is little that the teacher can do to help the failing pupil. Somehow, the assumption continues that there is a deficiency in the learner—not in the teacher or his methods. But the pupil's learning task has been imposed under one set of learning conditions. Surely it cannot be said, on the basis of so small a sample, that the pupil will fail to learn the task in *all* other possible learning situations. A more profitable approach seems to lie in the search for an optimal set of learning conditions.

Since our immediate concern is with instrumental behavior in the analysis phase of learning, it is tempting to list a pattern of specific operations to be carried out by the teacher in order to stimulate analytic behavior. Such a list has been prepared, but it is not presented as a recipe for in-

ducing students to behave analytically. It may, however, serve as a basis for further thought. Though the list of procedures does not rigorously conform to the implications of a functional analysis, it may prove to be convenient as an illustration on how a teacher may promote analysis on the part of the student. While each pupil has pencil and paper before him:

Write a concept on the blackboard. Suppose the concept "measure" is written.

Stimulate the pupils with the following directives and questions:

Clarification Items
Write in your own words the meaning of "measure."
Describe something that can be measured and tell in what way it can be measured.
Name something that cannot be measured.

Classification Items
(Write a list of terms on the blackboard. Some will name instruments of measurement.)
Pick out things that can be used as measuring devices.
Explain why you picked each device.

Interpretation Items
A man is eight feet tall and lives in a large city.
Describe five practical consequences that point up how he must live differently than people of normal height.

Evaluation Item
A man twenty-three years old plans to run for the presidency of the United States next year. Evaluate his qualifications. Is there more than one shortcoming implied or stated in the problem? If so, indicate them.

(The management of reinforcement after each task has not been outlined nor has the use of feedback. The illustration has been included mainly to stress the merit of including analysis as an important part of teaching objectives.)

PERSONALITY TRAITS

What sort of person is best suited for analytic tasks? The value of the trait question lies in a promise toward identifying worthwhile questions. There seems to be little value in attempting to show fixed trait patterns. However, it can be expected that the problems may be defined which will improve efficiency in changing traits, in establishing stronger patterns in the pupil. The perspective regards traits as highly malleable, and therefore they can be expressed as *goals* of education rather than as unalterable products. If a pupil is low in Trait *X* this is not to be taken as a rigid limitation but as a problem in education.

It is predicted that the following pattern of personality traits will correlate significantly with success in handling analytic tasks.

High	*Low*
thoughtfulness	compliance
restraint	flightiness
aggressiveness	*superficiality*
independence	outgoingness
meticulousness	agreeableness
carefulness	*duplicity*
honesty	

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CHAPTER 9

A Perspective of Education in Subject Matter: The Creative Phase

PSYCHOLOGICAL STUDIES of creative behavior have been gaining greatly in volume and scope. Research with tests and factor analysis of tests has refined some facets of creativity. It is now pretty well accepted that the field is a whole domain of behavior rather than any single class of responses. There is no need to go into the various definitions and shades of meaning which have been adequately treated elsewhere. Our purpose is to consider the value of creativity as a phase of education and to suggest how the teacher may help promote behavior that is both novel and productive.

WHAT IS MEANT BY CREATIVITY IN SUBJECT MATTER?

A pupil has demonstrated creativity when he has done one or more of the following:

a. The pupil has made novel connections between concepts. If the connection is new to him, then it must be accepted as creative. The new connection, however, must be coherent with some significant segment of the community of social action. Otherwise, we would have to accept bizarre ideas as creative. The point has been made by Mednick.

b. The pupil has established new uses or applications of knowledge.

c. The pupil has exhibited novel approaches to the solution of problems. This is a complex form of behavior which has not been adequately described. It is often one of the most fruitful forms of creativity because it usually involves a challenge of established assumptions. It thereby often opens up new categories of perception and action.

The behavior we shall call creative involves new relationships between concepts, novel applications of knowledge, and fresh approaches to the solution of problems. Creative behavior must have some coherence with some part of the culture. Yet it can be and often is incompatible with some conventional patterns. But it should not be incompatible or irrelevant to all conventions in a society. If it is, it has no chance of surviving and is therefore valueless.

Creativity as we have defined it relates to the three phases of education already covered in the perspective. Establishing new connections between concepts, for example, is creativity in the knowledge phase. New approaches seem to involve novel ways of analyzing situations. New uses are obviously creative forms of application. Creativity cuts across the other phases of education and is not neatly compartmentalized, existing separately in its own right.

Criteria of Success. Since creativity is relative to the pupil's past behavior, how can the teacher distinguish between a response that is creative and one that is imitative?

When we accept creativity as a phase of education we are conceiving of the learner as a valuable contributor to his culture. *We are accepting him as someone who can learn to create* rather than one who merely absorbs knowledge and creates either by accident or solely on the basis of native talent. If we show him that we value his uniqueness because no one else can be just like him, we have contributed to a profound sense of self esteem in the student. The learner is not to be treated solely as one who must adjust to the *status quo*, but as one who can help us change conditions for mutual benefit. Adjustment (not conformity) is a two-pronged concept. Adjustment *to* the environment and adjustment *of* the environment call for both conventional learning and creativity. To keep education humane we must place the qualities we use to define the human above those values that serve him.

The last stronghold of individuality is creativity. An individual may behave creatively *in* a group, though it would be incorrect to say that a group is creative. If the pupil is conditioned to feel that he is only a cog in a huge social wheel he may lose his integrity; that is, he may be prevented from experiencing his contributions as the most satisfying form of reinforcement. The form of self-control called integrity is formed when the person controls those variables which in turn influence him. He maintains his integrity when the contingencies of reinforcement which make up his belief system gain precedent over incompatible and external influences. The individual must receive social support for the things that he alone can express.

The general strategy for promoting creativity is to emphasize what is possible for the particular individual, while also reinforcing deviations, so long as they are not destructive. Groups should also learn to value the voice of the dis-

senter, when dissent is neither bizarre nor inhumane. Tyranny by the group can be checked by establishing values that protect creative action.

The above canons are not impossible to follow. They can he engineered hy the management of reinforcers. Creativity should be emphasized early and become a part of each pbase of education. As the learner matures, he sbould expand his creative behavior.

More specifically, the strategy for promoting creativity is subject to criteria which follow the rule already presented. First describe in detail the behavior patterns which are to be accepted as creative within a learning situation. As the nature of different subject matters is examined in terms of creative opportunities, some important properties unique to a field of knowledge may be discovered. Consider the idea of creative spelling. If we reinforce pupils for spelling as it seems best to each child, we would find many different ways of spelling a given word. It is desirable to stereotype accurate spelling because creative bebavior here does not promise as much positive value as it does aversive consequences. The learner seems to profit by overlearning, in spelling. Perhaps teachers should encourage overlearning of those skills which aid the manipulation of the elements of communication. These include spelling, handwriting, articulation, typing, reading, and phonics.

An important limitation in setting up criteria of success in creativity is the fact that blueprints of all the desirable behavior cannot be made. It may also be difficult to use the criteria of success as the hasis for reinforcement. It is sometimes difficult to know whether the child is imitating someone or has exercised his own freedom of expression. If imitation is reinforced, then the child will learn to imitate, not to create. The child's peers are often likely to note imitation

and are apt to reinforce only novel acts. (However, too much control by the group means group tyranny.)

A heterogeneous group seems more suited to cross-fertilization of creativity than does a homogeneous one because of the wide variety of behaviors. Integrated, composite, or unified courses carry a greater range of stimulation for making novel associations than do courses which are narrow in scope.

An aid to flexibility in behavior is to arrange conditions so that operant responses are encouraged. A sort of cafeteria of opportunities provided for the learner increases the likelihood of operant or voluntary behavior. Each opportunity should be somewhat structured, but the learner should be free to choose and initiate action. Valuable feedback is more likely to result from operant responses when there is some structuring. A series of demonstration setups in the laboratory, for example, should increase the number of operants and reinforcements.

In addition to having some knowledge of that which he is free to manipulate, the learner should have some idea of how to order and control conditions. Creative production presupposes some skill in manipulating the concepts, facts, and relations that make up a situation.

Let us review briefly the kinds of actions by the pupil that the teacher should note and reinforce.

a. Verbal expressions which make rare connections between words. The teacher should immediately identify the connections, recognize them openly, and draw the pupil out as to how he perceives them.

b. Demonstrations of new uses of knowledge or anything that suggests new uses. Give the pupil credit even if his behavior only suggests a new application.

c. Signs of making a novel approach to any problem. Look

for the ways in which a pupil views a situation. Encourage any manifestation of a promising perspective.

Teaching Functions. Typical behavior of teachers suggests that originality develops spontaneously and therefore is not to be taught. But the psychology of functional analysis is marked by its stand on educable behavior as having an almost unlimited range. Not only is originality an educable mode of action, but much of what is identified as intelligence, aptitudes, and personality traits also comes largely under the control of environmental stimuli. Our psychology is optimistic when it comes to education—education is a most powerful influence, often underestimated.

What are the teaching functions? We cannot yet answer this in detail. We can offer a limited illustration of how a certain kind of creative behavior may be engineered. This will point up the kind of thinking called for, and is not presented as a tried and true technique.

Before dealing with the illustration, let us state the concept which will provide implications for structuring the techniques. *Novel behavior is influenced by novel contingencies.* "Contingency" is an abbreviated way of saying "contingency of reinforcement." To make reinforcement contingent upon a response is to arrange conditions so that reinforcement follows emission of a certain kind of response. Bar pressing is a class of responses which rats learn in the laboratory. The occurrence of the reinforcer, food, depends upon, or is contingent upon, bar pressing. If the bar pressing meets certain criteria, then a reinforcer, food, follows.

If the aim is to shape the habit of bar pressing as quickly as possible, then the experimenter will use the method of successive approximations. If the aim is to increase frustration tolerance, then an intermittent schedule is used, so that the rat must work more and wait longer between reinforcements.

A novel contingency is a contingency of reinforcement in which there is a shift in the kind of behavior which is to be followed hy reinforcement. Those responses already conditioned are not reinforced under the novel contingency. *Changing* the *schedules* of reinforcement alters the amount of time and effort the learner will spend in responding.

In order to decide whether an operant is a novel one, we must know something ahout the history of the learner. If the operant is novel, then it is one which the learner does not emit by following a formula already learned and used. Also, the novel act is made up of parts which have other sources of strength. In learning a new concept, a person may know the parts but may not be familiar with piecing them together in the way that will be reinforced.

The steps in the procedure to be followed are:

a. State the behavioral objective. Detail it as much as possible, so that the kinds of behavior to be learned are clearly in mind.

b. Set up the conditions which are needed so that appropriate behavior is likely to be emitted.

c. Make the desired kind of behavior known to the learner.

d. Wait for the desired response and supply reinforcers accordingly.

Stating the Behavioral Objective. Some linguists claim that a person's thinking is limited by his working vocahulary. If words are tools of thought, then the thinking potential of a person would he increased by increasing the number of words which he understands and can use. One way of doing this would be to build new words by using those known. A behavioral objective might therefore be stated: *"To encourage pupils to form new words by combining those witb wbich they are already familiar."*

Setting Up the Needed Conditions. First we must choose some words with which the pupil is already familiar. Suppose

he is familiar with the words *justice, success, opine,* and *stroll.* We know that he can emit appropriate behavior concerning these, then.

Making the Desired Behavior Known to the Learner. We give instructions that the word pairs to be supplied to the student are to be combined by him to create new words. Two words already in the working vocabulary of the learner have been determined above. They are *justice* and *success.* The learner is asked to combine these to create a new word. He is also asked to combine *opine* and *stroll.*

Supplying Reinforcers for Desired Responses. If the learner has combined *justice* and *success,* for example, to form the new word *juscess,* then he has responded according to the desired behavior. He is to be reinforced by praise, recognition, or a token. Perhaps he also combined *opine* and *stroll* to produce the new word *opstroll.* We also reinforce this.

Once the desired operants have been emitted, we may use these as points of departure for added implications. The pupil is likely to enjoy "playing around" with his own creations. The teacher may ask him to:

a. Define the two new words.
b. Tell what things in our culture support whatever is meant by the words. (What makes it difficult? How could it be made more popular? Should it be taught to children?) The teacher could expand the concept as time and inclination permitted.
c. Relate the new words to events in history—to famous men—to the learner. Again, the teacher could draw upon his own ingenuity and that of the pupil.

Creativity through word combinations is only one possibility among many that appear when the notion of novel contingencies is followed up. Again, novel behavior is influenced by novel contingencies.

While the treatment of creative behavior in this chapter is admittedly sketchy, it is to be hoped that two points have been made. The first is that creativity can be influenced by direct methods of instruction. The second is that the tools in the psychology of functional analysis furnish a strong potential for developing an experimental definition of the creative phase of learning subject matter. The power of functional analysis toward making creativity educable is due to the fact that it contains tools which help in systematizing a reasonable approach.

Instrumental Behavior. Drawing out the implications from the psychology requires more time and space than are permitted at this time. The problems involved in the study of instrumental responses in creativity are immense, but they are not insurmountable. Present plans are for treatment in a later publication.

Personality Traits. What kinds of habits should a person have to acquire skill in creativity? We begin with guesses, as we have done in discussing the other phases. We may then adjust our position after some results have been found. We would expect those who acquire skill in originality rather easily to be characterized by:

High	*Low*
flexibility	rigidity
self-esteem	gregariousness
confidence	fearfulness
curiosity	conservativeness
criticalness	drive for security
open-mindedness	conformity
frustration tolerance	
general activity	

The Integrated Perspective. It is now important that we draw together the most significant aspects of the schema

which was presented in Chapter 6. The schema presented here is similar to the first one, but it contains additional details which have been developed in other chapters of Part II.

SOME ADDITIONAL REMARKS

Our perspective is not simply a list of educational goals along with a few facts. It is a pattern for structuring a viewpoint. An adequate perspective should include values, aims, articles of faith, and certain attitudes all woven together to make up a coherent position. The value of having a perspective as a guide for technological developments in education can hardly be overestimated. Let us look at some reasons for this statement.

One may have some skill in manipulating gadgetry, such as teaching machines, and be desirous of experimenting in education, but he is likely to make strategic mistakes if he has a narrow perspective of education. A researcher working with teaching machines who views education largely as a process for acquiring facts would develop programs virtually confined to factual material. He would probably discover some efficient ways of making and presenting the material. The success of this researcher and others like him might gradually place them in a commanding position in education because of inaction by those who see education in a broader perspective. Impatient gadgeteers might force a mechanization of education which would have an effect less desirable than that which now obtains. Fortunately, however, many experimenters in gadgetry recognize the danger.

It is far too easy to see education from an oversimplified point of view, while it is actually a highly complex process in

TABLE 2

Phases of Education in Subject Matter

	INFORMATION GETTING	APPLICATION	ANALYSIS	CREATIVITY
Criteria of Success	Recognition Recall	Using information to solve problems external to the subject matter	Ability to clarify, classify, interpret, and evaluate elements of the subject matter	Ability to make novel connections between concepts, new uses of information, and novel approaches to solve problems
Teaching Functions	(Can be derived through the use of the psychological model)	(To be derived through the use of a future model)	(To be derived through the use of a future model)	(To be derived through the use of a future model)
Instrumental Behavior	(To be experimentally determined by testing operating rules)	(To be experimentally determined)	(To be experimentally determined)	(To be experimentally determined)
Personality Traits	Predicted ones: docility, suggestibility, industriousness, need for achievement, and others	Predicted ones: flexibility, objectivity, stability independence, general activity, and others	Predicted ones: thoughtfulness, restraint, aggressiveness, independence, carefulness, honesty, and others	Predicted ones: flexibility, self-esteem, confidence, curiosity, criticalness, open-mindedness, general activity, and others

PART THREE

CHAPTER 10

Analysis of the Lecture

LET US attend directly to the development of the promised operating rules. To make clarity optimal it is necessary to define the lecture and to indicate the most common responses that result from lecturing.

Definition of the Lecture. The lecture is an uninterrupted verbal presentation by a single speaker to an audience. Without the defined restriction it may be difficult to test the operating rules which follow because a broad and loose definition may not serve to distinguish between a lecture and recitation.

The typical responses which occur during a lecture include:

a. Note taking.
b. Subjective reactions.
c. Attempts to remember the content.

Operating Rules: Taking the first model statement, "Objectives to be learned are clearly presented," three testable hypotheses can be stated.

a. If the instructor specifies the objectives clearly at the beginning of the lecture, then notes taken by the students will contain more points relevant to those objectives than if no mention of objectives is made. The rule can be tested by controlling the presentation, as, for example, with a tape recorder so that all other stimuli given by the lecturer except the objectives are held constant.

b. When objectives are clear, subjective evaluation by the students will contain fewer aversive remarks about the speaker than if no objectives are specified.

c. If specific objectives are made clear, then a test of immediate recall will result in higher scores than if the objectives are not mentioned, provided the test adequately covers the goals indicated.

The content is presented in small information task units. As said before, the purpose of this suggestion is to keep the students active making responses relevant to the information. We can indicate a few operating rules appropriate to the model statement.

a. If the speaker directs the students to complete sentences with key terms which have just been introduced, then the value of the notes for review will be greater than if no such tasks are indicated.

b. If the speaker provides a sample of problems which are to be worked after the lecture and directly indicated as relevant to an early test, then the work output of the students will be higher than if such problems are omitted. Work output can be measured by the amount of written material performed. Time can be controlled if notes and allied work are collected after a specified period of study.

c. When the lecture contains a reasonable number of task units, student evaluation will contain more remarks that

refer to "getting somewhere" than if such tasks are omitted.

The information task units are arranged in a sequence to maintain high continuity.

a. If a series of task units are correlated in the sense that the solution of the first aids in the solution of the next, and so on, then the presentation of a set of such units during the lecture will result in greater test achievement than if no task units are provided. (It is assumed that the criterion test will relate to the tasks.)

b. If a lecture is presented in the form of a series of task units that are highly correlated, then students selected at random during recitation periods will manifest more correct verbal responses than students not having the task units during the lecture. (It is assumed that the recitation period will be used to review the topic of the lecture.)

c. Presentation of a series of correlated task units during a lecture will result in more student remarks that suggest satisfactory achievement than if the series is omitted.

Each task unit contains ample cueing to predispose success. If students fail to complete the tasks because of undue difficulty, then learning will be less than if cueing had been sufficient to maintain the difficulty level within the capabilities of the learners. From this interpretation further operating rules can be drawn for management of the lecture.

a. If verbal hints, cues, and prompts are provided to help students deal with the task units, then notes taken will be more serviceable for passing tests than if the task units are difficult.

b. If students are told that the solution of the task units are relevant to tests to be given, then the inclusion of such units will receive greater attention than if students are not told about the relevancy of them to later tests.

c. When important tasks are liberally cued for the student there will be less negative reactinn to the lecture than if few or no cues are provided.

A model answer is available to the student after he has completed each task. The emphasis is upon making the correct answer available to the student so that he can compare it with bis effort. Because the lecture is a means for stimulating a group simultaneously with the same verbal delivery, it is difficult to meet this requirement with complete satisfaction. The following operating rules, however, can be tested to see if their use can improve acquisition of information.

a. After the speaker has presented each task unit and pauses a while to allow students to jot down an answer, then he should ask those students to raise their hands who want confirmation. If the number wanting feedback is estimated at 10 per cent or above, then the instructor should provide the answer plus a brief explanation. If this rule is followed, the effectiveness of note taking will be greater than if the rule is not invoked.

b. An alternative to the above rule: If the speaker provides students with printed sheets with answers to each item so that feedback is available during the lecture, then the overall efficiency of acquiring information will be greater than if no feedback is provided.

c. To influence the student to use the text more effectively the speaker can hand out feedback sheets with starred items to indicate those likely to be nn future tests. If only 50 per cent of the items are answered nn the sheet, students will make special effort to look up answers to starred items to which no feedback is provided on the sheet. Effectiveness of the rule can be assessed by comparing test results of

starred feedback items, starred no feedback items, and unstarred no feedback items.

The rate of pacing is set by the learner. The criterion points up both a possible weakness of the lecture as well as a challenge. If the criterion is a crucial one, then an uninterrupted straight lecture should be less effective than one marked with periodic interruptions by the students. On the other hand, it can be argued that it is a desirable learning objective to train students to follow a pace not under their control because many everyday experiences require keeping pace with information outputs controlled by others such as movies, television, and the like. Therefore, operating rules should refer to both positions.

a. If the speaker stops every five minutes to allow students to ask questions, then students will have some control over the rate of flow of information. The effect of interruptions versus no interruptions can be assessed by measuring achievement under both conditions.

b. Students can acquire skill in following a lecture set at a relatively fast pace if the lecturer begins at a slow rate and gradually increases it to the desired maximum.

c. In a series of lectures it is possible to assign students the task of asking questions submitted in advance as a partial means of structuring the content. One promising method of doing that would be to provide an outline of points to be covered in advanced lectures and to request students to hand in questions pertinent to the outline. Our operating rule can now be stated: When a lecture is structured along the lines of questions by students, then a more effective delivery can be made than if no such effort is made.

The lecture is set up and managed to minimize distracting stimuli. External distractions can be controlled by either

selecting a room free from traffic noises and the like or by invoking controls on the sources of external distractions. Our operating rules will be concerned only with procedures that tend to minimize internal distractions, that is, those generated by the students. If we assume that monotony is one condition which will tend to arouse distracting responses amoog students, we can test the notion by using a few operating rules. We can arrive at the operating rules by estimating the likely properties of the lecture which may give rise to monotony. Such properties logically seem to include the sameness of delivery in speed, loudness, and tonal quality. Another property migbt be consistency of the difficulty level of the small task units. If the difficulty is uniformly too high, then students will teod to give up and fewer notes will be taken than otherwise. If the difficulty is consistently too low, theo the students may see little need for listening and may begin to talk about other things among themselves.

a. If the lecturer alters his speed of delivery within limits that allow students to follow him adequately, then note taking will be more efficieot than if the rate of delivery is uniform.

b. If the lecturer alters his loudness of voice to place stress on important points, learning will be more efficient than if no such modification is made.

c. If the difficulty of task units varies within a range so that a few items may not be immediately solved by most students, then attending will be more concentrated than if the difficulty is uniformly high or low.

d. If the difficulty of task units varies within a range so that a few items may not be immediately solved by most students, then the reactions of students requesting feedback will be greater than if the difficulty level is uniformly high or low.

A review test is presented that makes clear to the students the specific behavior needed to meet the objectives.

a. If the lecturer concludes his delivery with a set of essay questions that can be answered by successfully performing the individual task units given in the lecture, then learning will be more efficient than if no such questions are provided. The effect of such questions will be increased if students are told that the items are quite similar to those to be given on future tests.

b. If the lecturer punctuates his delivery by three or four summaries during the lecture, communication will be more effective than if a single summary is given at the end of the delivery.

c. If every fifth lecture or thereabouts is dedicated to reviewing the essential points covered previously, then learning will be greater than if no such reviews are provided.

In what ways can the teacher use the operating rules to manage the lecture? They have been stated in terms that lend themselves easily to inclusion or to exclusion. The teacher, however, may find that operating rules tested one at a time may show little effect on learning outcomes. Therefore, the recommended procedure is to use a block of rules at a time, selecting those that seem compatible; in other words, test a *block* of rules which can be conveniently invoked. It is easy to pick those rules that are handily managed together.

FURTHER CONSIDERATIONS

Let us now be critical of the modifications of the lecture which we have recommended. Suppose that we find that the nearer the lecture approximates the tutorial situation the

more improved are recall and recognition test scores. Have we actually improved the lecture? The question is relevant because it relates to functions having different ends. The answer to the above question is "yes" *if* we are merely trying to alter the lecture to improve its value as a medium for getting across a large amount of detailed items of information. But to accept that answer may cause us to miss a valuable possibility, implied by these questions. Should the lecture be used as a means for shaping behavior in minute steps? If not, why not? What other teaching objectives are better suited to the lecture than the goal of *detailed* shaping? These questions seem to be fundamental because it may not be wise to alter the lecture so that it merely becomes more efficient in shaping behavior by small bits. Let us try to answer these questions and point up how experimental data can be obtained to test the answers that are suggested.

First, let us consider an argument for using the lecture in ways other than minute shaping. The argument runs as follows. It is not profitable to try to force the lecture into the role of shaping small changes in behavior comparable to the teaching machine. The lecture should be used for other purposes. We should use it as an orientation medium, as a means for reminding the learner of important principles, for integrating facts into larger units, for emphasizing perspectives, and principally for stimulating the feelings of the student. The lecture should stand as a model of verbal behavior for dealing with a topic, issue, problem, and point of view rather than as a means for presenting detailed facts. A good lecture should contain some drama so that important ideas can be retained for long periods. The drama should not be misused. It should be employed to help the student bridge the gap between simple recall of information and the broader significance of such content. It should therefore stimulate

the emotions, imagination, feelings, and creative tendencies of the learner. A good lecture, in short, should inspire the listener to see the general significance of the subject matter. Instead of presenting small, factual bits and minute tasks, as in programmed materials, the lecture should contain larger problems, it should illustrate strategic approaches to problem solving, and it should point up exciting possibilities that linger at the growing edge of a discipline.

Many good instructors in college and elsewhere already use the lecture as just described. They do not employ it to compete with the teaching machine. We are raising again the basic question of educational technology, namely, "How can the media of instruction be managed to promote behavior called for by the various goals found in education." The question implies a promising approach toward the understanding and control of teaching media. The approach makes a sharp break with traditional research in methods of instruction. The traditional practice begins with a typical objective, to find out whether or not one kind of teaching method is better than another. The trouble with the objective is found in the shaky assumption on which it rests, namely, that different educational goals need not call for special methods of teaching. Furthermore, the traditional approach often rests on no perspective that points up differences in the phases of learning and differences in aims. It fails to relate the various criteria of success, instrumental behaviors, specific teaching functions, and the individual differences among learners. The technological approach begins with recognizing that education has a number of learning phases, each one having certain goals which call for particular ways to stimulate success, to measure outcomes, and the like.

The technological perspective regards the teacher as having at his disposal a number of media. The problem is not

periment which has some relation to the point given above. He was teaching an off-campus course in an extension center. One of his campus friends, a war veteran pursuing a degree, was found to be quite verbal about many things, even topics he knew only slightly. The instructor was amused by the glib generalities that his friend could display and by the convincing manner in which he delivered them. It occurred to the instructor to invite his glib friend to address the extension class on a topic that the glib one knew only vaguely. The speaker was introduced to the class, which was directed to take notes. The intrepid "expert" arose and conducted a most entertaining period. He barely touched the subject matter, tossing out a few generalities here and there along with stories which had some vague connection with certain points. The class sat with full attention. Students obviously liked the speaker and asked him a number of questions at the end of the lecture. He was so deft in answering the queries that he made students appear satisfied even when the questions were hardly considered in his replies. He was applauded at the end of the talk and many students wanted him invited for a return engagement. When the regular teacher met the class the following session, he asked how they liked the speaker. Replies seemed almost unanimous in favor of the guest. Upon some delicate probing, however, no one in the class could recall anything of an informative nature that the speaker had said. There was little doubt in the mind of the experimenter that had the students been asked to rate the speaker by filling out a typical teacher rating form that our glib friend would have received top honors.

What were the factors that seem to account for positive reactions to the bogus expert? Certainly, it would not be tenable to suppose that the content of his speech was informative in relation to course content. Yet there was defi-

nitely an influence. The little experiment indicates that an audience can be easily sidetracked by reinforcements which have little connection with factual content, even when the purpose of the course is to learn content. The significant problem may be to determine how entertainment can be used to reinforce learning rather than being only a stimulus for amusement. Research on this problem should be valuable. Perhaps we need to know much more than we do before we can interpret the meaning of student rating sheets of teachers. We can hardly make any reasonable conclusion when we find that students show a large variance in their ratings. Without some means of following up the rating with further tests, it is premature to make judgments on teacher effectiveness based on student evaluations.

If the unique properties of the lecture are found in the speaker, functioning to stimulate affective behavior primarily, then we need to define a new set of problems. Pedagogically, that set of problems is to discover how the affective factors can be managed to promote goals of learning.

Referring again to the experiment with the guest speaker, an additional problem comes to light. The outcome of the experiment indicated that the students were satisfied with the speaker although they were given no information on content. Let us assume that the students were oriented toward acquiring information in order to pass tests. They showed no evidence of having seen a rank disparity between the speaker's behavior and promotion of the informative goal. If that was true, how can it be accounted for by our psychology? The concept called "prepotent stimuli" is helpful. A prepotent stimulus is one that is stronger than competing stimuli. We must recognize the possibility that stimuli emitted by the bogus expert were so powerful that they completely overshadowed the drive to seek information. Should we accept

this interpretation, assuming it true, as a limitation of the lecture or as an educational challenge?

Let us adopt the challenge. It is pointed up by the questions: How can students be taught to perceive stimuli that are irrelevant or incompatible with a given purpose? How can students be taught to minimize the influence of traits of the speaker that are not particularly pleasing? The questions have practical implications. For example, in separating the information from emotional appeal of political candidates, the skill would be useful. If the challenge could be met, then learners could screen out stimuli not suited to the goal. How can the student be taught to discriminate between affective and cognitive stimuli?

The value of using lectures to research the above and allied questions seems promising. A brief outline of an experimental program runs as follows.

a. Prepare lectures with various degrees of information and different levels of emotional delivery.

b. Present two lectures with the same informative content but with differences in emotional appeal. Measure the amount of recall and recognition of the informative content. Also, measure the retention over short and fairly long periods. Do strong emotional stimuli distort accuracy of recognition and recall? Do they tend to protect some points of factual content from being forgotten? If so, what uniformities can be found?

c. Present a lecture on tape that is full of emotional appeal with little or no information. Stop the tape at convenient intervals and point up what is happening. Analyze the presentation before the students. Invite reactions. In short, try to educate the skill of making discriminations between objective and subjective material.

d. Demonstrate the effect of informative lectures and

those having little or no information on scores of tests calling for recognition of facts.

e. Explore the effect of dramatic lectures designed to support informative content. The aim would be to help students recognize the behavior that affective presentations tend to strengthen and to weaken. Help students analyze the educative versus the exploitative use of lectures.

Let us now summarize the speculations concerning the role of the lecture.

a. The lecture is less efficient than other media in helping pupils grasp detailed information quickly and well. The learner has no control of the flow of material when presented via the straight lecture. Individual pacing, therefore, cannot be satisfied.

b. The lecture is probably effective as a dramatic means for presenting values, points of view, strategic questions, and it can serve as a model of verbal behavior for vocalizing issues, challenges, and broad implications of facts and of rival viewpoints.

c. It is perhaps inefficient to use the lecture for imparting a large number of points in *one* session. It is probably better to use the lecture to emphasize a few, perhaps no more than five, principles, ideas, or concepts per session.

d. It seems to be a useful medium for giving overviews and summaries. If it is used to orient students at the beginning of a course, it should include things to help them adapt quickly to the course. And in doing so, the lecture should specify objectives with supporting reasons, specify the nature of the course, indicate the role of tests, provide a clear description of what is to be done to reach objectives successfully, give information on the speed of coverage, relate the present course with an advanced one, inform the students of outside readings, and similar tasks.

e. In higher education, the lecture might be structured profitably around test questions which are handed to students in advance so that they can use the lecture as feedback for correcting their attempts to answer the items. Essay items may be more fitting than other kinds. The lecturer should probably leave some time open for questions and answers.

Implications for Teacher Training. If our analysis of the lecture is reasonably correct, what suggestions does it hold for training teachers? The most obvious concentration of skills would be found in speech and in dramatics. College teachers use the lecture more often than teachers on lower levels. Therefore, one requirement in training instructors for higher education would be experience in speech and drama with emphasis on techniques of getting and holding attention. Skill in articulation, control of pacing, and practice in memorizing with minimum reference to notes should be helpful. Also, if the lecture is a good medium for airing the pros and cons of issues, debating should be good training for teachers.

In the field of psychology, courses should be in the psychology of influence, personality, and learning. Teachers do not receive the kind of training in psychology to equip them to use such knowledge with ease and accuracy. There should be special courses for teachers that concentrate on the nature of basic concepts, the properties needed for ready application to instruction, and the analysis of theories to determine their scope of application.

Graduate courses for teachers that provide extra credit hours for earning higher wages should be more carefully prescribed than current practices indicate. The policy of allowing so many courses to count as equally useful on the graduate level appears to be wasteful.

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CHAPTER 11

The Group Discussion

LET US recognize the group discussion as free verbal interaction within a group, having either explicit or implicit objectives.

In order to make a fruitful analysis of any teaching medium it seems necessary to identify the kinds of stimulus functions involved and how they are controlled. The group discussion is a series of verbal episodes which are often loosely connected and which vary considerably in continuity from group to group and from topic to topic. The verbal contributions of a single participant are determined by the strength of available responses already established in his repertory and by the nature of the contingencies of reinforcement and punishment manifest by other members. In the main, most group members tend to select those operants which have some reasonable chance of being reinforced. Some persons may elect to say something that is unpopular, shocking, or

negative as reactions to things which are aversive to him or as a result of deprivation of approval. Other persons tend to inhibit their aggressive proclivities as a result of discriminative stimuli previously associated with avoidance. Thus, it seems unlikely that a group discussion is never completely free in the sense that no censoring occurs on the part of participants. Variables which control the kind and frequency of responses are largely the verbal reinforcements and punishments displayed by group members and by the teacher.

In group dynamics efforts are sometimes made to diminish the amount of threat and aversive reactions to increase the frequency of diverse remarks as a setting to promote acceptance of contrasting opinions. Attempts to reduce aversive controls seem to be valuable for broadening the stimulus range of the discussion. When negative feedback is strong and under the control of only a few participants, the discussion is little more than repetition of opinions in harmony with those exercising aversive control.

Group dynamics researchers have located some deterrents to free interplay, but it is questionable whether or not they have found efficient means of dealing with those deterrents. They have rightly made the point that group members must *learn* how to participate in the discussion in order to realize its full potential. We are now closer to seeing the unique features of the discussion than in our definition above.

Unique Properties. In a typical discussion, the most singular features seem to be:

a. diversity of verbal sources
b. diversity of background experiences of the participants
c. unequal probability among members to respond overtly
d. unpredictable continuity
e. opportunity for all members to contribute overt responses limited by group size

Goals Logically Related to the Unique Properties. Having identified the apparent distinguishing characteristics of the discussion, we can inquire into the kinds of desirable goals of learning that seem to be facilitated by the listed features.

Many decisions are made within group processes—in board meetings, in special committee functions, in conventions of various sizes, and in a variety of less formal groups. Consequently, it is desirable that students learn to function efficiently in the group setting by learning how to contribute, how to listen, and how to assess arguments and counterarguments. What specific goals can be appropriately assigned to the discussion medium? The following ones are suggested:

a. recognition of issues developed through verbal exchange
b. clarification of problems
c. broadening of individual verbal repertories
d. tolerance for diversity
e. evaluation of competing positions
f. growth in skill of presenting points of view

According to these objectives, the discussion is a complex and advanced medium when compared with the lecture. By "advanced" is meant that students need to have considerable preparation as a baseline of behaviors necessary to reach the goals.

It can be readily seen that the discussion is hardly comparable to the lecture or to more primitive media that use small step intervals, logically sequenced to shape efficient acquisition of information. The discussion presupposes a background of information and some basic skill in logical analysis. It therefore does not seem profitable to set up research to determine how well the discussion competes with the lecture or with a teaching machine or even the recitation. Many existing research reports that describe the comparison

of teaching methods in an attempt to find which one is the most efficient are conceived without regard to a logical choice of objectives. If the goals are qualitatively different concerning two teaching media, then it is unwise to attempt to compare them on any common basis. Our approach suggests a completely different set of tasks, namely, to determine which goals are most suitable to a given medium and to attempt to find the optimal management to help students achieve the appropriate objectives. To clarify the approach one can profitably begin with an educational perspective which identifies a rather broad range of functions.

Relevance of the Model to the Discussion. We ought to examine how our model developed earlier can relate to the management of the discussion. Can we use it to suggest optimal conduct of the discussion? We can use *some* of the statements in the following way:

Objectives to be learned are clearly presented. When the discussion is experienced by beginners, it is perhaps wise for the teacher to invoke controls to help establish a pattern that can be later managed by the students almost entirely. The teacher should make it clear that the purpose of the discussion is to identify and clarify issues and problems as well as to make significant contributions in order to judge them. The teacher can illustrate problems that are controversial as opposed to those which have definitive answers. He can show that a controversial issue is one that is not yet resolved because it is a locus of competing positions, some of which are based on plausible grounds. In order to demonstrate the kind of terminal behavior sought through the discussion, the teacher should have a good demonstration; for example, a motion picture. Also, a demonstration given by students already trained in discussions can serve the purpose of making the objectives clear.

The informative segments are arranged in a sequence to maintain high continuity. Again, this aspect is perhaps best initiated by a demonstration. The teacher can point out the parts of the presentation which carry continuity, and gradually transfer the task to the students watching a series of demonstrations. Later on, when students are presenting their own views of an issue, the teacher can reinforce instances of continuity, and he can use segments which lack continuity as the occasion for providing hints to help speakers emit improvements.

A model answer is available to the learner after he has made an effort. The teacher can provide valuable feedback by putting short classroom discussions on tape. Students can listen to themselves and make comments that reinforce the adequate parts as well as suggest improvements. Then, the teacher can play a tape on the same issue made by advanced students as a form of feedback for further discussion. The teacher can help the class compare and contrast the two tapes. As students become more skilled in handling the discussion, the length of it can be gradually increased. Early attempts should perhaps be short and therefore involve only a few participants. The class can be divided into a number of subgroups, which can be combined into larger ones as the discussion periods lengthen.

A review test is given to point up specific behaviors necessary to meet the objectives. An interesting implication of the group discussion is that evaluation logically involves the whole group, as well as individual members. This presents an opportunity to use some unique forms of evaluation as indicated by the following points.

a. Provide practice tests prior to ones that count. This allows students to grasp the relationship between objectives and mediating behavior.

role of reinforcing agents to maintain diversity and at the same time toward suggesting criteria useful for the evaluation of arguments.

As noted before, one valuable objective is the identification and elucidation of problems. Instead of the teacher presenting the class with a well-defined resolution for debate, it is perhaps better to help it recognize the issues that emerge as a *result* of the competing opinions emitted. The aim should be to give fewer and fewer prompts during such analysis until students themselves are carrying out the procedure as a final part of their regular discussion.

Students who exhibit originality in constructing arguments and during evaluation should be given special reinforcement. The teacher can help other students value originality by discussing the consequence of creative contributions. Some students may only get to the brink of an original idea. The teacher should look for implications here that could lead to creative responses and provide cues to suggest them, reinforcing the adequate completion of them. It is also worthwhile to suggest how students may recognize originality and to reinforce those who acquire such recognition. If this procedure is carried out in a nonthreatening way (minimum aversive stimuli) then it is likely that groups will adopt criteria of detecting creativity and will give it the proper recognition.

Where during the sequence of teaching operations should the discussion be found? According to our treatment, it is not something that logically begins at the initial phases of a course unless class members are already skilled in its management. A well-run seminar can be considered a model for the discussion. Good seminars ought to be filmed and taped as training devices for classes in the stages of acquiring skill in vocal interchange. Why filmed models of optimal conduct of teaching media are not more common seems to be a mys-

tery. The typical training film for teachers is a staged operation that reiterates truisms and platitudes. Demonstrations of skilled behaviors on the part of students are seldom shown. Students in classroom films are usually seen to be listening to the teacher, engaged in some project, or involved in a poorly managed group discussion where too many irrelevant and questionable contributions are reinforced.

The discussion provides no magical means for creating the best answers to problems. Rather, it is a medium which students must *learn* how to use. Beginners at the art should operate under close guidance of the teacher. And as skill grows, the teacher gradually assumes the role of a spectator. The principles used by athletic coaches are relevant to perhaps the management of all media. A good coach typically begins with a great deal of individual attention, providing specific feedback to correct inefficient movements and reinforcing signs of progress. He also progressively plays less and less an active part. As a result, his reinforcers become more and more intermittent because he has taught students how to evaluate themselves. The effective teacher of skills assumes the role of a coach.

We have not dealt adequately with the discussion because it is primarily a medium to promote application, analysis, and creativity. Our model was set up only to furnish a basis for making operating rules for suggesting how the teaching of content can be managed efficiently. We can see, however, that the discussion is not devoid of the informative function. When differential assignments are given and students report on their preparations, then new information is most likely presented. We have tried to suggest how points in our model can be used to enhance some of the informative procedures found in the discussion. (The authors hope to present a more detailed treatment of the discussion in a later publication in

which models for application, analysis, and creativity are treated.)

Implications for Teacher Training. If the aims and functions of the discussion presented in this chapter can be accepted, then there are certain preparations teachers ought to have to help them manage the lecture efficiently. Courses in semantics, logic, speech, group dynamics, and the use of audiovisual devices would be appropriate. Training in the art of debating may also have some value as a means for presenting arguments coherently, for using appropriate criteria to assess assumptions and the adequacy of the grounds on which positions are based.

Should elementary teachers also be trained in managing discussions? It seems that upper elementary grades are perhaps the ideal place to initiate the discussion. Average fifth and sixth graders can certainly learn how to identify simple issues and problems. They should also be able to profit from watching demonstrations of effective discussions and enter into the first stages of the art in small groups (perhaps not more than four of five per group).

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CHAPTER 12

The Motion Picture

As mentioned earlier, it seems profitable to examine a teaching medium from the standpoint of beginning with its unique features and proceeding to the logically related teaching functions and objectives. From an educational point of view, certain features of the motion picture are indicated.

a. Presentation of a wide variety of visual episodes in motion. The scope of pictured events extends far beyond the real episodes existing in the classroom.

b. Flexible control of perspective. Pictures can be shown from macrocosmic to microcosmic proportions. The latter can be enlarged sufficiently to bring out details not otherwise visible to the naked eye.

c. Effective controls for establishing and maintaining attention. The motion picture is typically shown in a darkened room, making a vivid contrast between relevant and irrelevant stimuli. The controlled frame of light projected on the

screen is a means for focusing attention, particularly when the visibility of distracting cues is reduced.

d. The phenomenon of apparent motion can be harmonized with audio stimuli. Thus, visual and audible inputs can be used to broaden the scope of coherent stimulation.

e. Films project a fixed sequence of visual scenes. The medium is inflexible in the sense that it presents a single order of visual episodes and any elaboration or spontaneous branching must be gotten through other means such as from discussions.

Teaching Functions. How do the unique properties just mentioned suggest ways that the learner is stimulated by films? There seems to be two principal forms of stimulation.

Orientation. When a learner is oriented he has acquired a space-time predisposition, meaning that he becomes aware of how to *direct* his behavior from a given point within a context toward likely reinforcing consequences. It also means that he becomes aware of the temporal order of responses likely to result in reinforcement. The film can depict the space-time structure by presenting either a symbolic or actual picture of the context. Thus, discriminable stimuli associated with chains of responses can be indicated. Orientation is successful to the extent that cueing in the film provides a reliable map of reinforcing contingencies of similar situations later experienced by the student.

Imitation. Orientation and imitation are similar in their over-all effects. While orientation is a space-time map of reinforcing contingencies, imitation emphasizes the response side. The one being imitated (imitatee) demonstrates a mode of action that results in reinforcement. When similar behavior on the part of the imitator also brings reinforcement, the strength of imitation increases. While orientation requires no model of behavior, imitation depends upon actual

demonstration of a behavioral pattern as a model to be approximated. Orientation can be provided symbolically while imitation is stimulated through demonstration.

The net result of orientation and imitation is to increase the probability of certain behavior *before* the learner has actually behaved in ways suggested by the two processes. Thus, they act to influence the learner to *want* to act in a given manner. And this wanting is the meaning of motivation.

To make a full account for the effect of motion pictures on behavior can hardly be done in a simple way. But, as noted before, the gist of its influence seems to lie in broadening the scope of stimuli to which available behavior can be emitted at a later time. For example, an actor in a drama may predispose imitation to reject filter tip cigarettes in favor of nonfiltered ones by ripping off the filter and smoking manfully in a reinforcing situation. A number of complaints by business firms have been registered against certain filmed scenes that have shown actors not wearing such things as undershirts, hats, and raincoats in situations normally involving such apparel. Drastic reduction in sales has been claimed after release of films having such scenes.

The psychological process seems to involve a higher order conditioning of the classical (Pavlovian) type which is mediated by verbal behavior. Films have apparently strong potential for getting imitation emitted by showing that certain reinforcers follow a mode of action. (Incidentally, the argument for censoring movies seems to have psychological support. When, for example, a criminal is shown "getting away" with a crime, resulting in a variety of reinforcers, while others who repress such behavior are seen to experience aversive consequences, the influence on naïve viewers is likely to be significant. Generalization or induction is promoted by

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showing discriminative stimuli associated with the unlawful acts, which are followed by reinforcers. To assume that all naïve viewers will not be influenced by films that glamorize immorality is dangerous because of the fact that moral training, imposed by parents and by schools, has a large range of variance. Consequently, we cannot be certain that the child has developed behavior that is strongly incompatible with the undesirable action depicted in the film. There is an urgent need to explore this speculation through experimental means. One predictive hypothesis is that the influence of films is significant on those viewers whose behavioral repertories contain only weak responses that are incompatible with the depicted and reinforced action.)

While a number of motivation films have been attempted and used with conflicting results, it is notable that the making of such films has not been done to any great extent by systematic use of applicable principles of behavior. It is not very profitable, therefore, to review existing research in the area.

Since one of the most pervasive problems in American education centers on motivation, it would seem that the development of films for meeting the problem may bring rewarding consequences. Let us explore some possible lines of action that may improve the motivational power of the motion picture.

The problem of motivation implies a twofold task: (a) to examine and alter the curriculum so that its effectiveness to meet everyday contingencies is improved, and (b) to use existing media so that they have a significant influence on the desire to learn. While the first task is beyond the scope of this book, a few suggestions on broadening the curriculum are given in passing.

a. Increasing frustration tolerance. As the demands of a

technological society increase in complexity, the occasions that give rise to frustration grow in frequency. Therefore, the need for conditioning frustration tolerance is an urgent one. Techniques found in behavioral analysis promise that such can be done without inducing fear, anxiety, or other negative emotions.

b. Sensitizing awareness. One of the important characteristics of child growth is that many discriminations are learned as a function of training and education. Behavior becomes increasingly differentiated. Our present curriculum offers no systematic training for improving acuity in general observation. Early psychological efforts to measure accuracy of observation under limited exposure time were not productive except to show that individuals vary considerably in ability to retain accurate data after observing a complex field. The validity of testimony has been brought under justifiable doubt, but little has been done to improve accuracy and retention of observed facts. Current innovations in Soviet laboratory schools include training in observation and verbal description of experienced phenomena. Results indicate that youngsters not only improve in the art of observation but that they gain twice more than untrained pupils in verbal ability in making accurate descriptions. That many of our citizens cannot provide an adequate description of people whom they have known for years is perhaps sufficient testimony to the fact that they have engaged in no special effort to see some aspects of their environment accurately.

c. Flexibility. As automation brings about a redistribution of demands for human skills, there is an increased need to stress flexibility in education. Attention given to adjustment is typically found within the psychoanalytic framework, which emphasizes inadequacies, limitations, and weaknesses rather than focusing upon improvement through normal

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learning procedures. Standardization of reinforcement contingencies leads to conformity which is incompatible with flexibility. It is likely that verbal behavior of Americans is becoming more and more standardized through the impact of mass media, although the media could just as well be used to encourage more flexible verbal patterns. Peer group controls among teen-agers induce remarkable patterns of conformity, yet there is nothing in the nature of adolescence that dictates that such rigidity is inevitable. The highly skilled learner acquires flexibility largely through fortuitous contingencies. The poor learner seldom uses the ability he possesses partly because he tends to perseverate in unfruitful action when faced with problems. Our curriculum could easily incorporate systematic training to improve desirable forms of flexibility.

So far we have identified some unique features of the film, two associated psychological stimulus effects (orientation and imitation) and a promising educational goal (motivation). (To call motivation a goal rather than a prerequisite is simply to recognize the significance of the problem in education.) We are ready to identify some practical ingredients of the film which can suggest a set of testable hypotheses that represent the outcomes of our analysis.

Ingredients for Effective Orientation. We have said that orientation is a map of reinforcing contingencies and that its influence on behavior depends upon the reliability of the map. Psychologically, this means that the map must represent contextual elements in about the same relationship as experienced by the learner acting in similar contexts. The discriminable stimuli and reinforcing consequences must be approximately the same between the pictured and real contexts. The influence of effective orientation is manifest in generalization or induction, meaning that the filmed and

real contexts, in which the learner operates, must contain common elements sufficient to predispose the desired behavior. Also, intended *reinforcers* must actually represent reinforcers to the learner. And so the requirements for an effective orientation include (a) a map that contains the essential structure and relations of some field, area, or context, and (b) an indication of how a behaving organism functions within the context to bring about reinforcing consequences. Thus, the orienting structure serves as a network of discriminable stimuli for giving *direction* to behavior. A context having clearly defined contingencies of reinforcement functions somewhat as a maze in which blind alleys represent negative contingencies, and open pathways to the goal represent positive ones. A good orientation is a perspective of the real maze.

Ingredients for Effective Imitation. A general formula for inducing imitation should probably contain (a) a demonstration of behavior which the observer is capable of reproducing, (b) clearly defined reinforcers which are contingent upon certain acts, (c) a context which is accessible to the learner, and (d) a type of demonstrator who is not aversive to the viewer—one that displays features that the observer likes.

Taking the ingredients for orientation and imitation, we can now present some testable hypotheses for predicting the kind of film, and its management, that will predispose motivation.

Hypotheses:

a. If the main parts of the map of a topic, process, or situation are clearly indicated, as well as their relationships, then motivation will be stronger than if such elements are confusing to the viewer.

b. If a clear indication is given of the *direction* in which

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the learner is to move within the map structure, then motivation will be greater than if no direction is suggested.

c. If the filmed learners and the viewers are peers then more motivation will result than if the same movie is presented to a nonpeer group.

d. If the viewers interpret the pictured learner as having socioeconomic status similar to their own, then greater motivation will result than if such similarity is significantly less.

e. If the task to be learned is placed in a context that is positive to the viewers, motivation will be greater than otherwise. (Feeling tone toward the context can be measured by such devices as the semantic differential and by an adjective check list.)

f. If the filmed context is similar to a situation often experienced by the viewers, motivation power of the film will be greater than if such similarity is absent.

g. If the filmed learner is shown to experience reinforcers acceptable to the viewers as a result of successful learning, then motivation will be greater than if such reinforcers are absent.

If the hypotheses were used to develop a film with all the suggested characteristics and compared with one devoid of them, yet with the same cognitive conteot, a reasonable assessment of the present analysis could be obtained.

Managing the Film to Promote Acquisition of Information. While our analysis suggests that the film is perbaps best used to promote motivation, it is worthwhile to examine the film as a means for teaching many items of information. What parts of our model seem to be incompatible with the unique properties of the film? An answer to the question can help us eliminate the least useful statements in the model.

The most difficult rule to apply would be: "The rate of pacing is set by the learner." The student cannot usually stop

the film when he pleases except under unusual conditions. But the teacher can roughly satisfy the condition by stopping the film periodically and by stimulating a discussion on its content. So one operating rule would be: (a) "If the information film is stopped at several convenient intervals to allow for discussion of its content, then the bits of information that it contains will be more completely acquired than if no discussions interrupt the showing."

While the given rule is in line with a part of our model, we predict that acquisition would be less efficient than through reading a text or a program. The experiment, however, may be worth doing. Any learning situation which depends on self-pacing would probably be better managed by using a medium less awkward to control than the film.

The statement which calls for a review test would also not be most convenient to administer, especially if there were a large number of items in the film. If, however, only a few items are given, the condition may be reasonably met. But when we speak of information getting we assume a high density of factual bits, which normally require many test items for adequate coverage.

Objectives to be learned are clearly presented. This statement in our model brings up an interesting issue in education, highlighted by the difference between the discovery method and traditional instruction. During discovery the student is often not fully apprised of the exact response classes he is to acquire. Exploration and discovery amount to self-determination of objectives through a searching procedure that involves certain strategies as found in game theory. It is a kind of heuristic maneuver that puts the learner into the role of hypothesis maker and tester, and the modification of his tactics depends upon feedback resulting from his operant behavior. The teacher usually gives a minimum

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of direction. Just when discovery should be used and when it should not is an empirical question; but there is little doubt that much time can be wasted in learning through attempts to discover facts and relations that can be acquired more efficiently by other means. Discovery is perhaps best used *after* the learner has acquired skill in learning and when no other more time-saving means are available. It seems that skill in learning through discovery presupposes a repertory of behavior that includes such things as familiarization with basic terminology, fundamental facts and relations, and some fairly broad orientation. In our perspective, discovery seems to come within the creative phase of learning where the teaching functions are largely under the manipulation of the learner with minimum dependence upon a teacher or a tutorial device. The cueing system is not prearranged as found in a program; therefore, the alternatives open to the learner are less well-defined and *appear* to be greater, although in some cases they may be very few in number.

The teacher may use discovery at almost any point, but according to our analysis it is most efficiently employed when the learner is ready for it, meaning that he has acquired certain fundamental knowledge and skill in manipulating the variables such that promising hypotheses in dealing with problems can be inferred from his attempts to discover. But our model is primarily aimed at furthering the information getting phase of learning, and it therefore logically presupposes clearly stated objectives. So we must keep in mind that our present consideration is simply the management of films to promote information getting as defined by the acquisition of a large number of information bits that serve as a reliable descriptive pattern of some body of content.

How can the film be structured and used to present a

highly detailed set of objcctives? There is no doubt that almost anything or process can be filmed, including a list of terminal behaviors of a detailed sort. But the fact that self-pacing is awkward when using films with groups seems to suggest that presentation of a list of narrow classes of terminal behavior is much better achieved througb a printed sheet that the lcarner can keep in his notebook rather than copied from a film. Notice, that we recommend the use of films for orientation but that is not the same as presenting a long, detailed description of terminal bebaviors. Therefore, it does not seem appropriate to attempt any operating rules for using films to present numerous specifications of detailed objectives.

The content is presented in small information task units. Can the film serve as an effective program similar to the many printed programs made as either linear (Skinner type) or as scrambled books? The question is quite relevant regarding the feasibility of the above model statement. Filmed programs actually exist for certain training situations as found in industry. The learner sits before a demonstration film and imitates the action he sees by manipulating material things such as the assembling of a television antenna unit. But most such demonstrations involve slides or film strips rather than motion pictures. There is, bowever, no reason why motion must be eliminated. If the frames are short and adequate feedhack is given, the learning of motor tasks via filmed programs sbould be rather effective. But when information is of a verbal sort, involving no manual dexterity, the use of movies as programs seems unnecessarily expensive. A better arrangement would involve either slides or film strips along with tapes as audio inputs for detailed programming of verbal knowledge. Our tentative conclusion is

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that to use moving pictures to program small bits of information to help students simply recall and recognize such content is to engage in an inappropriate use of films.

The remaining statements in our model also seem to present awkward problems in attempting to modify films for stimulating acquisition of small items of content. Therefore, it does not seem promising to pursue any further the identification of operating rules concerning information getting.

Implications for Teacher Training. In general, the tenor of this book suggests that trainees need special experience in dealing with instructional media on a systematic basis. Courses in educational psychology should contain the bases for analyzing teaching situations and developing hypotheses that can be tested in the classroom. More specifically, students should receive training in choosing and managing motion pictures during practice teaching, and they should learn how to estimate the effects of various presentations. We have said that films seem most useful to promote orientation and imitation which combine to stimulate students to want to learn. Therefore, trainees should study the nature of motivation and acquire skill in identifying how increased motivation can be inferred from behavioral changes.

When motivation is approached from the standpoint of behavioral analysis it is a term which serves as a convenient class name for increased strength of observable responses. Motivation amounts to the management of stimuli so that a predisposition to act a certain way increases by providing certain *promises* of reinforcement. Both orientation and imitation processes of managing stimuli seem to act as promises because reinforcement for certain acts is observed and behavior is largely vicarious.

Trainees should learn how to examine the stimulus functions of films and to relate those functions with manipulable

variables. Thus, experience in dealing with films experimentally appears to be fundamental. The typical audiovisual course does not combine the psychological analysis with the training in the mechanical functions and operations sufficiently to come within the suggestions indicated. Therefore, alterations in audiovisual courses should move toward the inclusion of psychological forms of analysis. Without such inclusion, students are likely to deal with audiovisual devices as mere gadgets.

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CHAPTER 13

The Field Trip

THE FIELD trip is a guided tour for observing some thing or process which cannot be examined in the classroom. Its unique properties lie in the fact that the visited object cannot be conveniently experienced in the school. Thus, it requires a radical change in the learning environment when compared with the usual academic situation. It can be used as a link between information getting and transfer. It can provide information, but unless the pupil carries with him an appropriate background of knowledge, a positive learning set, and some definite aims, he cannot reap the optimal benefit. A fruitful field trip implies preparation, which can be made a cooperative effort supplemented by individual study.

How can the teacher help pupils prepare for a field trip? And how should the trip be conducted? If our opening remarks are sound we see that the field trip is a logical step in the process of providing natural reinforcers for the student. If a class in civics, for example, is on the topic of American

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courts nf justice, a well-planned field trip to a local court could be highly reinfnrcing.

Preparation. The field trip should nnt merely fit a convenient empty space in the course. Tn promise a trip to the local water plant if the whnle class accelerates in arithmetic is nnt a gnod decisinn; any pupil who may fail tn accelerate will be the nhject nf resentment. A trip to a fire department, museum, or a water shed shnuld be built up as a reinfnrcing event contingent upon adequate background experience. The student should have learned how to behave so that reinfnrcers appropriate to the aims can be realized. Hence, orientation and preparatinn for some imitation should be gotten.

An effective preparation for a field trip may begin with a film nf the site to be visited. The film can provide an orientation and show examples of good learning behavior. Teachers can initiate procedures to get valuahle sites filmed, allowing some students tn participate in film making for preparation of less advanced classes. The next logical step may be a discussion of things that should be acquired befnre the trip can yield its top benefits. Discussinns early in a project can be used tn help pupils hecome aware nf the things they dn nnt know but shnuld know. It can be helpful in planning an informatinn getting phase implemented by books, nther films, further discussions, prngrammed materials, and demonstrations. The management nf media should not be estahlished in a definite and rigid sequence but should be made flexible to fit special ohjectives.

In the early stages, the teacher can *stimulate* a *feeling* nf deprivation, that is, nf things that should be knnwn tn get the most from the trip. He can pose questions which nught to be answered through individual and group research in the

library. The teacher should not act as an authoritarian because authoritarian decrees are usually in the form of contingencies that prescribe punishment, that it, "If you fail to do such and such the consequences will be unpleasant." Positive reinforcement is no less a means of control, but it is pleasant for the learner and promises to result in greater transfer of learning than the inhibiting effects of punishment. It is not control which typifies authoritarianism, but only control based on threat. Our psychology states that control is omnipresent. Even the laissez-faire situation is rife with control. It is the control of caprice, which is often not efficient in productive action. (Backward societies that may seem to engender a carefree and happy life are often the most shackled by control based on misconceived causes. Superstitions, as Skinner has pointed out, seem to be developed by accidental contingencies of reinforcement. As they gain in strength they can enslave a group and repress progress toward the effective interaction with the environment.) Ignorance perhaps harbors the most authoritarian practices. Control should not be seen as something necessarily bad. We are always controlled to some extent by surrounding forces. The problem of gaining freedom lies partly in understanding how behavior is controlled so that initiative can be taken to alter forces of control to suit common objectives, such as freedom from war and misery.

The following questions can serve as a checklist for the teacher who wants to manage the preparation of the field trip. It would be worthwhile to compare the results of a trip based on adequate answers to the questions with one that is simply made to fill a convenient empty space in the time schedule.

a. Does the topic under study suggest a field trip which

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would be a logical extension of the topic under study?

b. Have the pupils been stimulated to think about possible trips which accord with the topic?

c. Has a discussion been set up to allow students to become aware of things needed to get the most from the trip?

d. Does each student emerge from the discussion with some set of tasks which, when accomplished, will provide valuable information to the group?

e. Have students been stimulated to prepare a checklist of things they want to see during the trip?

f. Have they been encouraged to develop questions which they expect to have answered during the trip?

g. Have adequate physical preparations been made such as for transportation, lunches, and the like?

h. Has each student been properly reinforced for his contributions?

i. Is it worthwhile to stimulate students to prepare a written report of the trip for a newsletter or class bulletin?

j. Is the group large enough to call for division into smaller groups during the tour?

The questions should be sufficient to suggest how the planning stage may be conducted to bring in a number of the conditions in our model. Each question could be rephrased as an operating rule or hypothesis. Since the field trip presents such an imposing set of preparatory tasks, it is probably best to run only one experiment. Simply compare the trip that has been planned to agree with adequate answers to the questions, to one that is devoid of such preparation. Our model predicts that a large difference should be found.

Conduct of the Trip. "But I don't see why you can't just . . ." That may be as far as John got as he thought aloud about the operation of a kind of special valve. The teacher did not want any interruptions of what the guide had to

say, so John had to be reminded to be quiet. John had made one of his infrequent responses, but it was not reinforced. Once before he had tried to find out something, but then too he had refrained from further responding because he was laughed at for his "ridiculous" question. Were his responses ridiculous, or were they creative? A report card may have said something about John's not participating very much, but that is as far as any analysis of his problem went. There is not much likelihood that John's abilities will be understood under these conditions. He simply will not be selectively reinforced for responding frequently, and responding will remain at a low level. On our hypothetical trip, high frequency of responding typically marks only the guide or perhaps George Highmarks.

Does John turn a valve, throw a switch, trip a pedal, or even simulate these by going through the motions? Does he become so oriented to any operation that it permits him to run through the operations even mentally? If he does not, he makes only errors of omission, not of commission, and there is no cueing system because he has not been able to trace a path along the trail of active learning. The field trip is not to be used as an opportunity for relaxation from the chores of learning. It ought to be used as a means for showing that learning has different phases and that it is an adventure. Notes gathered before the trip, outlines and drawings furnished by the teacher, a planned progress through the site, all will supplement communication as a cueing system to control error level.

Children need to be able to inject some meaning into the treatments and routings which they experience. If knowledge is to be active rather than to refer to some words in a notebook, pupils should be helped by many cues, which can be gradually withdrawn without leaving them barren of in-

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formation and meaning. Cueing need not be continuous and repetitive. The gradual withdrawal of cues may be accomplished subtly so that pupils can make the transition from being led by the hand to doing much on their own so easily that it is hardly noticeable. The teacher needs to be on the alert for ways to reduce cues. Industrial sites usually have processing that can be broken down into convenient stages, connected in such a way to provide a convenient program of cue reduction. The alert teacher can take advantage of the continuity and help pupils construct items that have the "fading" property.

Sometimes teachers and guides like to see how practical a student's learning has been. If questions are aptly phrased, most pupils will be able to answer questions about many phases of the tour. Teachers can acquire the skill of aptly phrasing questions by two simple guidelines: (a) Always ask questions that are directly related to the objectives, putting them in such a way that the kind of behavior indicated in the objectives is likely to be emitted. (b) If a student fails to answer a question, do not turn to other students until the question is answered; instead of that, break down the question into easier parts and increase the cues until the student can answer the item satisfactorily. When a student shows signs of not being able to emit the desired behavior, that is the signal to begin teaching. Successful teaching means to manipulate cues so that the terminal behavior is manifest by the student. And, of course, each student should be reinforced for successful response according to his level. Just as in the classroom situation, there will be opportunities for reinforcement by successive approximations. If Andrew is asked whether he understands the chlorination and sedimentation processes in a city water plant he may mumble "Yes" or nod his head only to avoid embarrassment. Further pressure, such as asking him to go ahead

and explain (too large a segment) may put him on the defensive and add nothing to his knowledge. A smile or other sign of approval is likely to be given most frequently to those pupils standing nearest the teacher. They can ask and answer questions and can be reinforced. There will be too many others who have not heard, who do not understand, who will pretend to know anyway, and they will be reinforced in the *absence* of knowledge. Thus, it is important that reinforcement be both individual and appropriate.

Should review be postponed until the day after the field trip? Should it take the form of a brief discussion while at the site? Or should there be elements of review throughout the tour? This is the concern of the immediacy of feedback. Whether it is feasible to review or to summarize as the tour progresses will be limited by the occasion. It is left to the teacher to determine the conditions which are best suited. The least that can be said is that there should be provisions made for students to be kept informed on the results of their efforts to learn.

Tours need to be conducted in an orderly manner. When Edward asks, "Say, Mr. Brown, is this pressure gauge on the feeder line just like the one in the . . . ?" and the teacher says, "Oh, Eddie, don't bother Mr. Brown about that now, we have to get on to the next room," how can Eddie determine whether he has the right idea or not? He may find other means for self-evaluation, but it is the function of the teacher to provide as many of these means as possible, and a verbal check on learning progress is more immediate and more available than many other forms where the behavior of the pupil is limited. For example, children cannot interact freely with complicated machinery that is dangerous.

A city water plant is filled with strange noises, escaping steam, moving machinery, and unusual smells. Not all field trips would be quite the same. But even visits to greenhouses,

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museums, zoos, aquariums, or to radio and television stations have their own unique distractions. If distracting stimuli are not to be allowed to disrupt learning, their effect must be controlled. There are some general methods that are worth considering. For example, deliberate calling of attention to and explanation of distractions will tend to minimize their disturbing aspects. In the case of many, it will reduce the strange to the familiar so that students tend to perceive the distractions only as background rather than as centers of attention. In the case of escaping steam, for example, which is making a peculiar moaning sound, an inspection of the origin, along with explanation of it, will serve to minimize it as a distractor. There may be a pungent odor that can be explained to them by the man in the boiler room. There may be a harsh grinding noise which he can explain.

One method of reducing the effectiveness of distracting stimuli is to increase familiarity with them. A second method is to shut them out. On a field trip some masking of distractions can be done before the students enter the area. Doors may he closed, vents rechanneled, and many temporary measures taken to restrict the range of stimuli. Students should not be denied the opportunity to find out about sources of distraction, but their concentration can be facilitated temporarily.

One of the most common distractions is the student himself. If in the course of what is usually the most loosely structured learning situation the teacher finds it expedient to pay attention to only a small group while letting the rest wander at will, the wanderers are in a position to distract the remainder of the group. Some of the concentrating group may even join the distractors. One way of dealing with this is to conduct only a few students at a time through certain phases of the site. Students in small groups can attend better to

what is being said and shown and can be reinforced more frequently than in large groups. When should no supervision at all prevail? Perhaps *after* the guided tour and when no danger to the student and property is likely the freedom to examine things without supervision may be best. The student can follow his curiosity and use his supervised learning as information to develop and work out answers to further queries.

Does a field trip end with a return to the classroom? Would the class like to describe the tour to another class? If so, it would provide opportunities for each student to participate. Pupils might volunteer to describe phases of the trip. Does this suggest other means of motivating pupils to look upon the field trip as desirable?

The foregoing has not been intended to serve as a specific model for the conducting of field trips. It has shown that the medium can be managed to yield substantial learning experiences. It can obviously be mismanaged, too.

The general suggestion has been that field trips should receive more attention through planning than is often the case. There are several aspects of planning which have been covered. A posttrip operating rule can be stated as follows:

> When the field trip is followed up by opportunities for describing phases of the trip to other classes, pupils will retain the knowledge more effectively than otherwise. They will receive reinforcement which will induce motivation. This general hypothesis leads to several specific ones. There may also be some predictions of effects upon enrichment when the trip is followed by opportunities for searching out related materials in the library. The pupils will initiate more research after a second trip has been announced.

The field trip can act as the occasion to synthesize learning gained in the planning stage. It is therefore a medium of

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maintenance and transfer and can promote application, analysis, and creativity. Follow-up discussions should be used to stimulate creativity because questions can be posed about different ways in which observed processes could be run, novel uses of the products noted, and different approaches to the problems discussed at the site.

Operating rules have not been rigidly deduced from the model as might have been expected by the reader. There is good reason to follow a flexible rather than a tight form of logical inference. In the first place, developments in the processing of learning concepts have not matured sufficiently to allow full value to ensue from a mathematico-deductive system because the premises are not sufficiently established to accept them as completely valid. On the other hand, there is value in using an intrinsic model as produced in an earlier chapter because it can be used as a source of suggestions. Also, it can serve to sustain coherence, which is often lacking in the looser extrapolations commonly found in educational psychology. The problem of coherence can hardly be adequately solved until development of basic generalizations is sufficiently validated empirically to bring logical deduction safely within agreement with empirical operations. The point here is that while good logic can be maintained by using one of a great variety of postulate sets, the disparity between the postulates and reality must be reduced through proper experimentation. Until such disparity is reasonably low, mathematico-deductive methods may lead us wide of the mark of efficient application. The practical upshot of this problem is that researchers in education need to set up experimental procedures that lead by steps from the animal study, with its many controls, to the complex operations found in the classroom. When such work has been adequately

performed we should have postulate sets, empirically validated on the classroom level, from which rigorous logical deductions can be made for future experimentation. This means that we yet have no adequate theory of classroom learning and that such theory must come through the hard labor of defining application procedures through carefully sequenced experiments. The present method of attack, found in the chapters of Part III, represents only a temporary means to approximate systematic application in the absence of much work yet to he done. Therefore, it is the hope of the authors that efforts to refine attempts initiated in this book may lead to the kind of knowledge and theory needed to place educational psychology in the legitimate class of applied sciences.

Implications for Teacher Training. It seems obvious that trainees should have experience in analyzing the field trip from a psychological standpoint, to determine its unique features, its limitations, and the kinds of influences that can be reasonably expected from it. The course in educational psychology should provide the basic concepts needed for such analysis along with illustrations and actual student experiences. Also, methods courses should provide for the design and actual conduct of the field trip worked out in cooperation with the regular teacher of the classroom involved.

Other implications for training indicated in the previous chapters on media are also applicable.

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CHAPTER 14

Automated Devices and Programmed Materials

PRACTICALLY EVERY teacher in this country must eventually have some contact with one or more "teaching machines" and "programs." A dual purpose may be served at this time. First, the student of education is to be provided with sufficient background to allay certain misgivings. Second, when it is recognized that the teacher is not to be replaced by a kind of mechanical monster, then he may proceed to make more useful decisions than otherwise.

Despite the reassuring voices of such pioneers as Pressey and Skinner, school systems are still filled with teachers and students who recoil at the very thought of using any kind of machine in teaching, although the term *audiovisual aid* fails to induce revulsion. The new educational devices come under the audiovisual instruction department of the National Education Association. At least one college has partially

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overcome the antipathy toward the new approach by naming its experimental department as the "Department of Self-instruction." But that name also arouses the specter of a classroom devoid of human contact, where all students are learning by machine on a production line basis. Perhaps only experience with these educational aids will serve to reduce crippling biases. At any rate, some information on what may be expected will enable the reader to form his biases on the basis of an informed background.

PSYCHOLOGICAL BASIS FOR MACHINES AND PROGRAMS

Most teachers have read something about the motivating influence of providing rewards for desired performance. Many will have heard of new approaches in which the pupil is moved to achieve by reward in preference to methods stressing interpupil competition. Competition has its rewarding aspects—for a successful few. Most teachers have hoped for some sort of ideal situation in which the pupil would be moved to learn because he wanted to learn from a kind of internal satisfaction. Few realize that some experimenters already have devised methods by which many students, rated as poor achievers, have been able to achieve with increased efficiency.

Typically, the low achiever begins lagging quite early in his academic career. He falls behind his fellow learners at an increasing rate. Not only is the student likely to lose motivation in his areas of greatest deficiency, but he may develop anxieties when forced to compete with more successful students. Davidson calls competition "the cradle of anxiety." It is difficult for a teacher to induce internal satisfaction

which will motivate the pupil to get data for solving problems. Research with automated teaching devices and programs has been directed at increasing the benefits from building internal satisfaction by increasing the possibilities for success.

Most of the automated devices have been developed to present material according to the principles of reinforcement advocated by B. F. Skinner. Because his psychology is so important to the hypotheses still being tested, some essentials of his theory will be reviewed in covering the analysis to follow.

Reinforcement. As already noted, the idea of providing a reward for achievement is a good one, but the common procedure is to reward those who succeed in beating their classmates. It is possible to reward a student for successful performance without reference to the performance of others. If we make the reward contingent upon small units of behavior rather than upon larger outcomes, we shall be able to move the pupil along the path to successful acquisition. A principle may now be stated: *Units of material to be learned will be small enough to permit the student to respond successfully almost every time a response is required.*

When the student is able to respond successfully, the fear of failure begins to subside. He is rewarded by his own feelings of achievement. But he needs to feel that his successful response was no mere accident. He who has failed repeatedly needs to be successful repeatedly to restore feelings of confidence. The more the pupil finds that he can respond successfully, the greater is the probability that he will continue to respond. He proceeds along a trail to learning baited with inner rewards. Experience has shown that the greatest effectiveness results when his responses are frequent. Another principle is: *Responses will be frequent.*

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No teacher has ever been able to break up materials into small enough units to suit each individual need and to provide each student with knowledge of how appropriate his numerous responses are. This would amount to private tutoring for each pupil, along with detailed notes on lessons, expertly arranged. And even if each teacher had the training and skill to do it, he would not have the time. The course material needs to be programmed by specialists. The material must be given to the student in a form which he can readily acquire. Various machines have been designed to present programs unit by unit and to permit the pupil to respond and know of his results before proceeding from one item to the next. The pupil feels rewarded when he learns that his response has been correct, and a well-designed program makes correct responses occur about 95 per cent of the time. Machines furnish feedback information by exposing a correct answer after the student has responded. Another principle, therefore, is: *The learner will be provided with knowledge of the appropriateness of his responses.*

The above general principles give rise to more detailed considerations which will be discussed more fully later in the chapter. For now, we may note that the details are concerned with control of the flow of material, inducing frequent responses, minimizing errors by cueing, stimulating response evaluation, providing a quasi-tutorial situation, arranging for voluntary response stimulation, minimizing distractions, and cue reduction. The reader will have noticed that these details pretty much coincide with the earlier presentation of our model for optimal information getting. It is true that they constitute a condensed version of the conditions we have been using to analyze other media. All forms of automated devices make use of some or all such conditions. Let us now examine two kinds of machines, some programs,

and programmed textbooks, noting how they meet the criteria.

Teaching Machines. Some writers are reluctant to call the devices "teaching machines" for two reasons. First, they point out that the machines do not actually teach but only make possible the conditions which will increase the probability of learning. Second, machines are not always necessary for the presentation of programs. The punchboard, for example, does not resemble a machine. The two kinds of special textbooks which we shall discuss are not machines.

Pressey's punchboards were first used to facilitate multiple-choice testing. Administration and grading of tests were speeded up. If the learner was able to punch all the way through a hole which represented his choice of answer to an item, then his response was correct—a "winner." All other punches in that row were incorrect because he was unable to punch through. Scoring could be accomplished as the learner progressed through the test. The learner himself knew as soon as he had responded whether his response was correct. The recency principle in learning states that a learner is more likely to remember his most recent experience than those more remote in time. The punchboard seems to instrument the recency principle by making the last punch (response) to an item the correct one.

Pressey and others experimented with punchboards and with a rotary type machine as aids to learning rather than only as testing devices. Subsequent studies of multiple-choice devices suggested that they could be valuable in helping the learner acquire facts. Multiple-choice presentations require the learner to recognize a correct alternative from among a list of responses already given. Since recall requires more activity on the part of the learner, many specific aims are promoted by exercise of recall instead of by recognition.

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The Skinner Machines. It is more accurate to say that the Skinner type devices require constructed responses than to say that they require recall. Some programs are arranged to permit the student to examine the item before him so that he might determine which answer he ought to write or construct in the space provided. A description of the machines will be facilitated by an explanation of how some programs are constructed. The machine is a device for controlling the presentation of the program.

Skinner's work with rats and pigeons had shown that the animals could not be expected to carry out a complex performance frequently enough to strengthen by reinforcement within any reasonable amount of time. That is, he found it inefficient to wait until a rat had done a complex act correctly before applying reinforcement. So he reinforced partial patterns before the final act. After being reinforced for doing an initially small segment, the rat was reinforced for adding small improvements to his behavior until the whole complicated pattern was completed. Bit by bit the final complex behavior was built onto the original behavior. The animal learned by a series of successive approximations to the desired behavior.

When Skinner and his associates began experimentation with devices in human learning, they tried to "translate" what they had noted in the animal experiments to human learning. In programming, a topic is broken into bits of information plus a task for the learner. The units or frames in a program might be called "information-bit-task-units." Each little step in the right direction is reinforced until the learner has put together enough steps to permit him to understand whole concepts, topics, or chapters. Breaking up material into small bits, providing answers, and arranging units so that one bit of information leads easily to the next are the main aspects of programming.

When the program has been skillfully made, the exposed answer to a frame will be the same as the one written by the student. The student notes his success. He continues to succeed, gradually learning more and more, and each time being reinforced for additional responses and for more complex ones. Young pupils have been rewarded with candy or coins, but the reward of knowing that one has responded correctly usually suffices.

The rest of the story on teaching machines is concerned with refinements in design and with the testing of theoretical notions. For example, it is often thought necessary to prevent cheating. The pupil might cheat by moving up the correct answer and then moving the paper back down to write his own answer. Most machines have some kind of ratchet to prevent seeing answers before responses have been made. Some educators say that the aspect is not important unless the program is also functioning as a test, because the purpose of the program is to facilitate learning. If the learner does well by getting a preview of the answer, then the outcome may still be efficient learning. Others say that a program which causes a learner to require such help is not well made. The issue has not been decided.

A verbal description does not do justice to the niceties of programming, nor can the whole cloth be quite visualized. The items below are fairly typical and point up the essential features.

1. Humans behave in *observable* ways. We can understand humans better by _____ them.
   (observing)
2. When we observe a person in action, we observe his _____
   (behavior)
3. As behavior *changes* and develops into some new pattern, we say that learning has occurred. When learning occurs behavior must _____.
   (change)

4. When we observe the development of some new pattern of behavior we are observing the process called _____ (learning)

Notice that the pupil may start with minimal knowledge and by easy stages produce accurate responses. Success tends to be followed by more responding. Each step is related to the next to maintain continuity.

The drawing below is an example of what a typical machine is like, but it is not a picture of any particular machine on the market. Machines are of many sizes, shapes, and composition. Some are large and complex, about the size of a refrigerator. Others are small and simple.

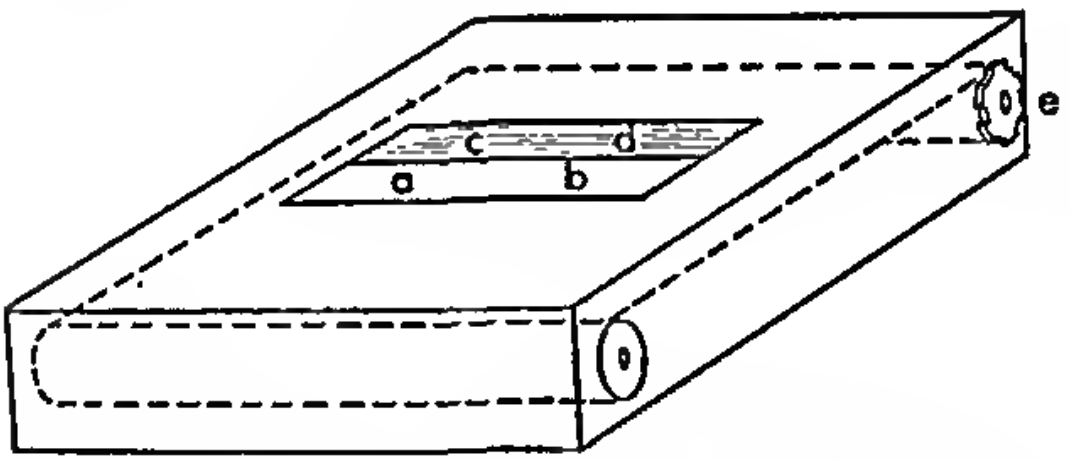

FIGURE 2. Model of a simple mechanical teaching machine. (a) Exposed item. (b) Correct answer for previous item, and space for student response to exposed item. (c) Previous item. (d) Student's answer to previous item. (e) Take-up knob.

The Program. The program is printed on paper which is often the width of a sheet of typing paper. It is then either placed stacked as sheets or folded, accordion style, and stored like teletype paper. The paper is fastened to the take-up roller so that a knob or lever may be turned or pushed to

move the paper lengthwise. The first item is moved into place behind the aperture or window. The learner reads the item, decides upon an answer, and then writes it on the roll. Sometimes a separate, narrow roll of paper is provided so that the student will not have to write on the program. After the learner has written his response, he rotates the take-up device until he can see the answer on the program. He learns almost immediately the accuracy of his response. Some machines prevent the pupil from changing his answer after he has seen the correct answer on the program.

Applying the Conditions of Optimal Information Getting. The reader is likely to be interested in more than a bare statement that the automated devices do meet most if not all the model conditions to a greater extent than seems possible with most other media. Just how well do they measure up, and what techniques are used for increasing the efficiency of learning?

The flow of material is under the control of the learner. The learner sees one item at a time. A single item or frame is usually quite short. In a mathematics program, a frame may consist of a single phase of a problem. In any case, the frame consists of a small bit of information. It is stated so that the learner can assimilate it readily, and he is able to respond to it easily and proceed to the next item, all in his own good time. His response may be either constructed, that is, supplied by him, or, he may select or choose one of several answers already furnished. The pupil is able to control the pace because he takes whatever time is necessary. He can pause to grasp the importance of the correct answer if his response is incorrect. Some programs include a brief statement of why along with the correct answer. If the steps are too detailed and simple for a student, he may skip some items. In any case, the slow learner is not required to keep

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pace with the rapid ones, and the rapid learner does not have to drag his heels. Anxiety is reduced, and important details are not lost in a presentation that is too fast.

The presentation of the material stimulates frequent responses. Responses are much more frequent than in most other forms of instruction designed to impart information. We exempt note taking although responses are quite frequent, because the action is simply a recording process. Notes are intended for review and not primarily for learning at the time notes are taken. While frequency of response is still a subject of experimentation, there is general acceptance of the idea that students seldom respond enough for optimal learning under traditional methods. During the group discussion, showing of a film or slides, and even during individualized reading, the student is not required to make frequent overt responses, nor is it often practical for him to do so. But the effective student may typically utilize the "Survey Q3R" formula, that is, survey the material, question himself about it, read it, recite it, if only to himself, and then review it. The structure of a program requires the learner to make overt responses before moving from one item to the next. Responses are frequent because items are brief. The student does not need to share recitation time with others; he is the sole responder. Even the slow learner responds frequently. Seated before the machine and its program, the student becomes, so to speak, a one-man class. It should be noted that the necessity for *overt* responses in programmed learning has not been established. Several studies have indicated that the program is effective if only implicit responses are made, that is, when the pupil merely recites the answer to himself silently. The data do not seem to be complete about the value of overt responding in the case of slow learners. According

to our psychology there should be some advantage to overt responding over implicit behavior.

The cueing system is used to keep errors to a minimum. Statements of high redundancy "give away" the correct answer so that the learner is apt to respond correctly. A successful response on one item makes success likely on the next item. There is a gradual, systematic progression from one frame to the next. Gaps which the student fills are small so that he is not required to assume several intervening steps. Ordinary textbooks often have gaps too large for many students to fill. One sometimes finds statements in mathematics texts such as, "It is therefore obvious that . . ." The only thing obvious is that something has been omitted, and the student may have to struggle to find how the author reached such a conclusion. Even then, only the superior student is able to determine the trend of the omitted steps.

Some cues are quite explicit to indicate the desired response. For example, if the item is "The knee jerk is an example of the ——— reflex," the word *patellar* may be prompted by furnishing p——. The rhymed cue is sometimes given, for example:

> 7 times 3 has given you fun
> Try 9 times 9 or ———

There are other methods which hint at the response by the context or theme used, making the proper answer just "naturally" follow. Definitions that are followed by examples often provide effective cues. "Set is a readiness to respond" may be followed by "Readiness to read is an example of a ——— to read." There are other methods of cueing which are used but which will not be covered here. Research on keeping errors to minimum has not unequivocally supported this

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practice as most desirable for all students, and in all situations. Some studies have shown that when errors are considerably higher than the five or 10 per-cent level learning still occurs satisfactorily. The optimal amount of cueing has not been determined presumably because students differ in the amount they need. If there is too much cueing the learner may react negatively, and complain that there is too much repetition. The solution of the problem may lie in further analysis of programs in order to provide directions for students to skip items after a certain number of successively correct answers have been given. The large computer-based teaching machines are designed to analyze student progress, and to vary the sequence of item presentation according to the individual's record of successes. But even repetitious material may be made free from monotony by adding variety and some entertaining side-lights. There is much yet to be done to properly manage cueing for all learners. Nevertheless, unless cueing is adequate, the student can easily get lost and is likely to lose motivation. We therefore believe that control of excessive errors through cueing procedures is important despite the fact that no optimal level of control can yet be named.

Self-evaluation is stimulated. The learner does not proceed from sentence to sentence merely by assuming that he understands the content. He is required to pause frequently to note differences between his answer and the keyed one. He does not guess; he knows the value of his efforts. He forms a habit of evaluating himself. Because he has furnished the correct answer, it becomes his last response to each item. In most learning situations the learner either has little chance to make frequent evaluations or has no means for checking against reliable criteria. He may be denied opportunities for carrying out both important steps.

The teaching agent reinforces improvement. Carr suggests that confirmation might be a more appropriate term than reinforcement because reinforcement might come from external factors. We shall consider factors which thus far have contributed to efficiency. One may be called "intrinsic reinforcement." When the learner reads an item, composes or chooses a response, and then notes his accuracy, he quickly begins to see himself as a successful learner. He is successful from the beginning and continues to pile up successes throughout the learning period. He does it on his own with minimum aid from others. If he errs, it is done in private, and he is immediately corrected in private. All corrections made are for his benefit; all progress is his progress.

Distracting stimuli are minimized. The learner confronted with too "busy" an array of stimuli is likely to indulge in mind-wandering. Time and energy are wasted as his attention strays, and he has to hunt for his place again. Machine presentation masks out all but the immediate item to be learned so that attention is centered upon a single frame. If attention does wander, it is easy to find the place again. Because it is *his* learning task, because he does not share time with others, not having to wait his turn to respond or to await the teacher's attention, he is less likely to become attracted to irrelevant stimuli.

Gradual reduction of cues, fading. Some media are arranged fortuitously so that cues are gradually removed. Usually, however, cues are not given systematically. In a program the material has been arranged with cue reduction in mind. High redundancy, contextual settings, and rephrasing are some of the components which seem to aid success. The learner is required to build on a foundation. References to helps given earlier are gradually withdrawn; that is, they fade. Optimal speed of cue reduction is still an object of

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research, but most programs use fading more effectively than do the other media as they are usually managed.

Immediate knowledge of results. When the pupil moves an item up under the glass plate, a new item appears. As he does so, his answer also moves up under the glass. The answer given in the program comes to view at this time so that immediacy of feedback is limited only by the amount of time it takes the pupil to move the lever. If he has been wrong, he is not allowed to retain the incorrect response very long. The program corrects him. If he is right, he may move on immediately to a new item. In either case, he receives rapid feedback. Whether he pauses to reflect or is impelled to broaden his knowledge by referring to other materials depends on the individual. This is self-pacing. Some pupils seem to need less feedback than others, but the important consideration is that it is *available* when needed. When cueing is high and the pupil makes the correct response, he is often certain that he is right before he sees the keyed answer. In such cases feedback may not add a great deal that is observable. As the learner's successes increase, he should become less and less dependent upon the feedback because he probably develops "internal feedback," that is, being able to supply reasons to support his response. The reasons are based on past knowledge he has gotten in the program. Therefore, if the program is made properly it should help wean the learner from depending upon it and prepare him to deal effectively with unprogrammed materials.

Most of the model conditions seem to be satisfactorily met by the teaching machine setup. Many theoretical aspects have been avoided. Only future research will resolve the theoretical issues. At the moment, self-instruction, as described, seems to be quite promising. We should not overgeneralize the bright spots to cover the whole picture of edu-

cation. The greatest promise of programmed materials seems to be in helping pupils get information efficiently. We are much less sure about its relevance to the other phases of education. As the technology of education progresses, the machines and programs we have now may be quickly outmoded. It seems wiser to regard the technology of education as the really significant movement and view teaching machines only as a minor development, because the era that lies ahead is filled with so many possibilities.

Programmed Texts. Programs have been put in book form. The structure is about the same as the programs which go into the machine. The book cannot perform all the control functions of the machine, but it seems to function rather well. To discourage peeking at answers before making responses, answers are usually placed on a different page than the item. Sometimes programmed books are arranged as follows: Item One, the stimulus appears at the top of page one with a space for the learner's response. The book's answer is not visible until he turns the page. Thus, the early items run along at the top of the page. When the middle of the chapter is reached, a second series of items is placed in about the middle of the page, and so on until the final items are sequenced at the bottom of the page. The procedure may sound confusing when merely described, but use of the book is simple. After the entire unit has been covered, the student proceeds to the next unit or chapter.

The scrambled text also uses a well-organized sequence, but the pages read are not in the usual serial arrangement. The student begins by responding to the first item, and his answer determines which page he must turn to for the next item. It is an interesting way for the student to proceed at his own pace. Responses are to a multiple-choice presentation, and the answer given by the student determines which

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page he will be directed to locate. On the page to which he turns he finds more information plus the next item. If his answer is incorrect, he will find some explanation given as to why he was wrong and he will be directed to return to the original item and try again. The student can only finish the book by finding correct choices because the pages are not in order; he could not make sense of the book in any other way. The scrambled book resembles maze learning which experimental psychologists have studied so long, using rats. Wrong choices represent the blind alleys in the maze. The more alert the learner is in taking advantage of cues, the fewer blind alleys he will experience.

The Content of Programs. Many subjects have been programmed. Various fine points are still being studied, such as whether it is best to reinforce the learner after every item or to provide intermittent reinforcement. Another important issue centers on the value of making errors. Some claim that valuable learning comes from making errors if corrective knowledge is immediately available. Others say that it is best to keep errors at the lowest possible level so that the inefficient process of unlearning mistakes can be avoided. The issue is not resolved.

The pupil who has been a poor achiever often makes dramatic improvements when put on an appropriate program. There is not yet enough evidence to settle the question of how permanent the gains are. Is improvement only temporary because of the novelty? The answer seems to be "no," but we do not know for sure. The proponents of programming do not claim to make brilliant students of dullards, but they do claim that achievement typical of certain groups can be raised significantly in a fairly short time.

Programs are being produced with increasing rapidity. In a few years, it seems that virtually all subjects will be pro-

grammed. Programs exist from kindergarten to college graduate courses. The list of programmed topics is now so long that we shall not even attempt to produce it here. The National Educational Association in Washington, D.C., maintains perhaps the most exhaustive current facts on programming.

Programs are not only used in schools but seem to have valuable uses in industry and the armed forces to reinforce training methods. Some attempts are being made to merchandise teaching machines and programs for home use. The effort has a noble aspect, because if the attitude toward learning can be improved the first important step toward realizing the vast potential of human learning will have been made.

Teacher Efficiency. At a time when teachers are being required to supervise, if not instruct, as many as fifty or more students per class, the advantages of programs seem evident. After students have begun work on programs, little supervision is necessary. The teacher may handle fairly large groups while machines or other program presentations are in use. Subsequent discussions and activities may then be provided for some class members, while others continue individual study.

It is not expected that the teacher keep pace with all the new developments in programming. It seems reasonable, however, to expect that he will need to build some supplementary program items and to add or delete items from those in published form. Several techniques for programming exist. It is suggested that teachers take a course of instruction on programming. Such courses are beginning to appear in some of the leading colleges and universities.

Individual Differences. While teaching machines should not be used for grading, there is a way in which they can permit the teacher to discover individual differences. As a

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child proceeds through a program, he may be given opportunity to make comments on certain aspects. At appropriate break points, such as at the end of a topic, he may be encouraged to discuss what questions it brings to mind and to state what aspects he would like to know more about. The teacher may then suggest books, articles, or other programs to enlarge his scope.

In clinical psychology we hear of the "testing of limits." It refers to the fact that an obtained test score does not provide as much information as possible. Scoring is structured in such a way that norms or expectancies may be used, providing standards of practice. The clinician often wants more information than provided by such evaluation. He may wish, for example, to know how long it would take the person to complete certain items, or how far he could go if given unlimited time, or how he may behave when certain rules are relaxed. "Testing of limits" could be arranged by supplementary programs. Those who had completed the standard program could continue up the scale to more difficult aspects. Supplementary programs might be extensions of standard ones, or they might be amplified aspects of usual programs.

Skilled programmers arrange their statements to sustain interest. In the early stages of development, most programmers were concerned with logical arrangement, gradual progression of difficulty, unit size, and cueing. It is expected that future formats will be enhanced by use of color, contrast, and other adjuncts to attractiveness. Machines may even take on appealing qualities and look less like machines. Many pupils, however, are attracted by whatever looks "electronic," "scientific," or "technical," and some machines have those advantages.

Self-competition. If Davidson is even partly right in saying that a pupil cannot long remain in the throes of competition

without developing hostility toward his rivals, and that the hostility is accompanied by anxiety, the programs seem promising. Self-pacing in programmed learning reduces competition between pupils and provides the basis for self-competition. The pupil may want to move from item to item as quickly as possible, but his progress is relatively free from pressure.

Student Creativity. Some laymen are apt to level criticism at any automated device. The assumption is that technology tends to make automatons of those who use the devices. The criticism will not hold, of course. In order for an individual to be creative, he must be familiar with the tools on which he depends so that attention to their use will not interfere with his associations. The violinist, for example, who must struggle with the mechanics of manipulating the bow, is not likely to be released for creative effort. In academic learning, the tools are facts and concepts—the information which the learner acquires in using the program. The tools must be acquired before they can be used creatively.

The Teacher as a Professional. The teacher is regarded as professional because of his education, his certification, and his occupation, and because of the techniques he uses. Some view his position as little more than a caretaker. The latter view is sometimes held by other professionals. The teacher himself may have doubts about the professional value of the tasks he is expected to perform. We believe that the essence of professional behavior is the application of systematic knowledge to a set of important social problems. The physician is able to apply facts, principles, and theories of chemistry and the biological sciences to the problems of health. Engineers have applied the natural sciences so successfully that they have produced the age of technology, which is marked by increased power over the environment. When

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scientific knowledge is applied successfully to practical problems, one inevitable result is increased power. The technology of education promises to provide the teacher with improved techniques of application. The result should be a greatly improved professional status.

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CHAPTER 15

Problems and Suggestions

THIS FINAL chapter is to enlarge upon some of the points and issues which were touched upon briefly in various parts of the book. We hope to suggest further how the intent to build a workable system of application relates to other problems of education. The following topics do not form any special sequence.

A Research Program for Schools of Education. There are many teacher training institutions which neither encourage nor allow time for research by the faculty. The reason often given is that teacher training exists in its own right, which has the clear-cut aim of helping trainees to become effective teachers. Furthermore, one does not have to be a researcher to teach well. Many cases can be cited to support the claim. Teaching is a full-time job and cannot be shared with other activities that call for time borrowed from the teaching load. The position also holds that the nature of research in human learning has not yet reached the stage where its results can

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be put directly to use by the teacher. Teaching is more of an art than it is a science. Consequently, research can influence it much less than the artful innovations which spring up in practice. All in all, research is too expensive to share with the process of training future teachers.

The above position was suited to teaching training schools before 1940. But today the position cannot be justified. There is one good reason why training schools which follow the given philosophy will fall further behind and eventually will be recognized as not having good enough programs to train teachers according to modern needs. Well-trained and bright teachers who have tasted the tonic of research will often avoid employment in training schools that discourage research. The most able young Ph.D.s in education are already shunning the schools which have no research opportunities. There is a pile-up of talent in the larger, better-equipped places which have research facilities and which expect faculty members to make original contributions.

While there are problems that come with dividing faculty time between teaching and research, some of those problems are spurious and manufactured by clinging to faulty assumptions. Two common phrases point up one such spurious belief. The expressions are "research *or* teaching" and "research *versus* teaching." They suggest that teaching and research are somehow incompatible. Apparently, the interpretation is based on the assumption that one cannot do two complex jobs at the same time. The assumption is faulty because it is only sometimes true. And the fact that teaching *is* a form of research is becoming more and more evident. Coladarci is the first keen observer, so far as we know, who has made the needed integration of research and teaching. Briefly, his reminder runs as follows.

The essence of research is first experiencing some problem

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of the problem is usually smaller to make it more manageable: greater care is given to the development and clarification of the problem; hypotheses are perhaps formed with greater rigor; controls, and methods of analysis are refined. But the general process is the same.

As the technology of education grows, it forges the link between theory and practice so that theory becomes a valuable tool for teaching. The theory-practice link is being developed with such promise that teachers can no longer afford to regard theory only as some unpleasant hurdle to cross while taking courses in college and as something to forget when back on the job.

We would like to suggest how a research program can be put together so that theory and practice can be used more efficiently than now to expand professional knowledge. In the first place, it is necessary to think of the research program as an integral part of teacher training. The trainees need to be exposed to research methods and to learn how teaching can become an effective form of research. To meet that objective, research facilities in training schools should have the following features.

Structure. A department of research should be established which is parallel to the other departments in schools of education. It should come under the same administrative head as the other departments. Its staff should have members that represent all curriculum offerings in the school of education. It should be composed of key persons who represent the foundations of education such as psychology, sociology, anthropology, history, philosophy, and sciences basic to physical development. The key researchers should form an interdisciplinary team which develops programmatic research made up of interlocking parts that contribute to the over-all effort.

Aims. Special effort should be given to drawing out the educational implications of the foundation disciplines and to develop researchable problems based on the implications. A second aim would be to develop research on enough levels so that a functional path leading from the basic theory to practice could be followed. Each level of research should be represented so that gaps between the implications taken from psychology, for example, to classroom application are filled.

The research arm should establish effective ways for bringing their findings to the teaching faculty through such devices as research seminars, demonstrations, and newsletters. The research department should have good communication with similar departments in other schools of education. A library of progress reports, both local and from other places, should be made available to the teacher staff.

The research arm should stimulate and coordinate studies in nearby school systems that want to test the value of advanced developments. Also, each school of education should organize effective means of using its laboratory school as the proving ground for developments that are ready for classroom trials. A full-time coordinator would probably be needed to arrange for time and space for making the practical tests.

Functions. The functions should instrument the aims just given. They include:

a. An informative action: to keep abreast of developments in the foundation areas and to inform the teaching staff of important implications for teaching. To provide the latest results of applied research and to suggest how applications can be made. To maintain a library of reports, and to hold seminars and demonstrations on new techniques.

b. Research functions: to develop a thematic research

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design which would encompass the many studies involved. To examine the foundations for the most likely points of effective contact with the research theme. To develop researchable problems from the implications taken from the basic disciplines. To carry out a series of studies so that a given implication is eventually translated into classroom action. This would require ample facilities; for example, in the psychology portion of the effort, both animal and human learning laboratories should exist side by side so that descriptive concepts discovered on the animal level could be studied as they are used in human experiments. We need to know how such a concept as "reinforcement," for example, changes its referents as it is moved from one experiment to the next so that its scope and facets can be seen and used appropriately.

Another function is to try to determine the dimensions that are common to the foundation disciplines. For example, the notion of "value" in philosophy should be related to terms in psychology such as *reinforcement* and *needs* and in sociology to ideas such as "mores" and "class structure." The idea is to strive for a core of communication that would facilitate interdisciplinary cooperation parallel to existing efforts in the natural sciences.

c. Consultation. The third large function would center on the liaison between the college of education and nearby school systems. The attempt would be to provide facilities and advice for application experiments in the field. Each school system should have a research division devoted to the design and conduct of assessment studies which try to pinpoint the advantages and flaws in the latest techniques.

It is believed that a design similar to the above would put a shot of adrenalin in the research activities of schools of education. It should help erase the false dichotomy of theory

versus practice and should hasten the day when teaching becomes one of the most, if not the topmost, profession in prestige and general influence.

The reader might not agree with the above suggestions on the ground that most large universities already have extensive research activities which seem to have little or no effect on teaching. The objection is based on the important fact that educational research so far has not influenced practice enough to justify its existence. There are two important points that help explain the strange lack of influence of research on teaching. The first point is that over 85 per cent of the studies are efforts to describe some part of education without regard to functional ties that *demonstrate* the power of manipulanda under the control of the teacher and pupil. In short, less than 15 per cent of research studies are experiments. That is not bad, per se, but descriptive studies require certain things to bring out their significance. Those things include: a taxonomy or classification system which can be used to relate the various studies that are couched in *ad hoc* terms. The second need is for an educational perspective to fit the many studies so that the descriptive parts can be united to fill out the large picture. And the third need is to *carry out* the integration so that the contributions do not hang apart as discrete blobs.

Educational research is largely *status* research aimed at describing things as they seem to be, without much effort to translate the knowledge into power, that is, to make it useful for the teacher. A radical change is needed toward shifting research from the status type to the power kind. The new movement, sometimes called "educational technology," makes such a shift. It is an attempt to put knowledge into action by forging the link between theory and practice. The link must be developed by investing heavily in the experiment,

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especially the kind that has features called "systems research." The essence of systems research is to take a number of input components (in education such components would include teaching media) and combine them in such a way that the desired output is optimal. The desired output is simply pupil achievement. The technology of education should be aimed directly at finding ways and means that can be used to get more learning per unit of effort on the part of both the teacher and pupil. In short, educational technology is a direct movement to increase learning efficiency. When problems are conceived in terms of efficiency, then the methods of problem solving take on engineering characteristics. Traditional research in education has not emphasized the engineering approach. Consequently, it has not produced power. It has not brought theory into the arena of action. Teachers cannot profit much by research in its present state. Therefore, they depend upon the *status quo*, which means that they perpetuate all the inefficient practices that probably inhibit the full development of the learner's potential.

Our suggestions are intended to conceive of the research arm as an institute of educational technology which always keeps its sight on the goal of putting knowledge into practice. It must work on the vast number of descriptive studies to order them into some coherent pattern to fill in a map of the area called education. The broad outline of the map should be influenced by educational philosophers who should contribute to the identification of the values and goals which can form the skeleton of an adequate perspective. The map should make the basis for building efficient practices of teaching and learning.

Let us now turn to one of the most challenging and exciting problems in the field of education. It is the problem of trying to make the philosophies of education into more active

functions for influencing the decision making that runs the schools.

Educational Philosophy and Its Instrumentation. One of the most notable aspects of educational philosophy is that educators and teachers tend to ignore its potential and fail to use it in everyday tasks. Why is it that philosophy is largely a verbal activity that seldom gets to assume the position of a strategic guide to practice? We see conferences devoted to the construction of educational objectives based on philosophy, but once the lists have been made their influence on everyday decision making seems strangely lacking. It is not so difficult to make a list of objectives in harmony with the democratic ethic, nor for that matter any other set of values. It is probably true that we have fairly high agreement on goals. No one seems to say, for example, that the learning potential of the child should not be developed; no one seems to deny the goal of health education. We agree essentially on the value of social development and on pushing for effective growth in problem solving, critical thinking, and adjustment. We can trace the goals to philosophical positions, or, at least, philosophies can support them. But why is it that philosophy somehow gets lost after such near consensus on its implications?

We believe that the problem is largely in finding how to instrument philosophy so that it can be translated into action efficiently. We suspect that the philosophers have not completed their duties. Perhaps the reason is twofold: First, many people may hold that philosophy should only define problems, analyze these problems and the basic issues, and develop some coherent set of overarching principles descriptive of theories of knowledge, reality, and values. And the philosopher's work is finished when he gets those things down on paper. Secondly, the efforts to bridge the gap be-

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tween the philosophical concepts and the actions they imply have not been sustained since the time of Dewey. The crux of the matter probably lies here. The reason seems to be that philosophers of education have not been active enough in keeping up with related disciplines such as psychology with its contributions that have a bearing on education. In short, the philosophers have divorced their work too much from other areas. Such a turn of events may be convenient and comfortable in some ways, but the upshot has been depressing.

What kind of work needs to be done to make the ideas in educational philosophy a part of the decision making of teachers? We suggest that strategies of action need to be put into forms that can be called "constitutions." The prime example of a constitution that puts a philosophy into broad rules of action is the Constitution of the United States. It is a document that not only carries values but it structures them into statements of action which are so broad that a whole way of life can be instrumented. We need a constitution of American education that provides a clear basis for guidance on how decisions are to be made in administration and in running classrooms. Even Dewey failed here because he never developed a clear role of the teacher. The constitution would be a set of broad rules which could be used to place current problems into a perspective. Local autonomy of schools should not be impaired by the existence of an appropriate constitution.

Any agency or organization with a mission can use a well-made constitution. The danger in making such an instrument would lie in undue elaboration and inclusion of too many directives and restraints. But it should be definite enough so that local policies made at distant places will not conflict with common principles.

The first problem to be considered is its feasibility. What would be the implications? Would it quickly become outmoded in the rapid changes taking place in our culture? Its nature should be such that the growth and impact of research would not be restricted. It should define some clear role for research and provide working principles for its growth and use of results.

The problems that would have to be considered are imposing. Among the most difficult of these problems is trying to develop a proper conception of technology of education. Let us examine why technology should be considered with great care.

The most influential development in Western cultures is the growth of the various technologies. Supporting evidence is so easy to see that we mention only two examples, the automobile and television. These two technological products have such an impact upon the way we live that it would be difficult to estimate the limits of their influence. The fundamental problem posed by technology is simply this: Can a philosophy of life, such as democracy, remain intact under the forces of technology? Which is uppermost, the ideals of democracy or the values inherent in technology? Can technology ever develop to such a point that it will be able to deal with problems that are now thought only to yield to philosophical analysis? The question points up the threat of technology to any system of values which may be designed to control it. Let us not underestimate the importance of the problem. We may think that science cannot answer the most fundamental questions. For example, it cannot tell us whether or not mercy is a higher value than justice. But science *has* changed the concept of the role of man in the broad scheme of things. It has had the consistent impact of making man smaller in an expanding universe in which God

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may have more important things to do than to focus on the welfare of mankind. Is the devaluation of man's place in the universe only a temporary one? Will science eventually agree with Christianity? Some seem to have faith that the two will merge with Christianity sustaining its rightful superiority. But how certain can we be of such an outcome?

Berdyaev and others have sounded the warning. He claimed that technology is bound to dehumanize us because it is based on epistemology which defines knowledge as *of* events external to man. He seemed to say that as knowledge of the objective (external) world grows, the stature of man will diminish to such a point that human values will be eclipsed. Such seems to be the meaning of dehumanization. To counteract the great threat of technology, he suggested an emphasis upon the study of reality, upon being, the meaning of human existence. He felt that Christianity can save man from destruction by the instruments of his own creation. Berdyaev strikes a terrifying note that gives intellectual respectability to conservatism. If he is correct, then we are in a very grave way because we have already gone too far to decide to turn back. Whether or not we agree with Berdyaev's treatment of technology, we must face the threat to democracy and try to determine the degrees of freedom that advancing technology seems to allow us in controlling it.

Our note on a suggested constitution for American education may not be a tenable one, but it does point up the need for trying to make philosophy a forceful element in our profession.

Anatomy of the Principle. In an earlier chapter we tried to indicate the various kinds of principles and to point up properties that lend themselves to application. We saw that some generalizations and concepts in psychology do not seem well suited for attacking the kind of problem we have

selected—improving the learning of information. Let us examine briefly two different kinds of concepts found in psychology that may give us some added insight into transmuting abstractions into action.

Inductive Concepts. Many Skinnerian terms are instances of induction. They stand for common elements in a range of observations. We say that they are factually based. "Reinforcement," for example, as Skinner uses it, does not refer to some hypothetical action going on in unseen quarters of the nervous system. It simply denotes a set of observed phenomena and the contingency relation which connects them. So we can see why reinforcement has such promising utility. It refers to observable operations which can, in part, be controlled to produce a desired outcome. It lends itself readily to the engineering mode. And that is partly why we see it take such a prominent place in the teaching machine movement, which employs engineering tactics.

Can inductive concepts be used in a theoretical way? If so, how? The answer is "yes," by extrapolating, or that practice which simply extends concepts into new areas. Skinner has done a great deal of extrapolating in his treatment of education, social behavior, self-control, government, and the engineering of an experimental community as described in *Walden Two*. The foundation of extrapolation is the assumption that analogy can be employed in science to jump from one area of investigation to another. (It is not actually right to say that analogy is *assumed* to work because it *has* worked.) Applied science could probably not exist without dependence upon analogy. But the use of analogy is not confined to the extrapolation of inductive concepts. It can also serve in setting up hypothetical models and for jumping from theoretical constructs at one level to observations on another level. The latter practice is the one that Skinner doubts as

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valuable for strengthening the science of behavior at its present stage of development.

"Transposed" Concepts. When Freud looked at the behavior problems of many patients and could not see directly the causes of anxiety, he was led to think that the causes must be hidden. His action was perfectly logical because to retain the idea of causation he had to locate the determinants somewhere. So he placed them inside the person and dealt with them as "instincts" which have come through in English translations as motives. Thus, motives are internal causes of outward behavior. The important thing at the moment is to see that motives are *transposed* notions, that is, the observations which form the basis of their existence occur at a different level than the locus of the concepts. The "id," for example, is not directly seen, but the observations from which it was generated were taken from patterns of behavior open to direct inspection. Outward behavior that could be labeled "blind selfishness" seemed to form the basis of the concept. The notion was transposed to an internal domain and became a part of a hypothetical structure which was invested with a number of properties, many of which were transposed abstractions taken from outer behavior. The internal psychosexual structure was set in motion as a complex mechanism or dynamism which was used to account for outer behavior.

The source of doubt about the value of transposed concepts is their efficiency for dealing with observations on the level which they are supposed to explain. The suspected inefficiency of the notions may lie partly in violating the law of parsimony which states that explanatory concepts should not be unnecessarily multiplied. Just how much of the Freudian theory is needed to develop and support the effective techniques of psychotherapy is open to question. And just how much of the theory tends to generate needless complexi-

tics in arriving at prescriptions is another point of doubt. The upshot is that transposed concepts used to form an explanatory system cannot be easily validated because of the circular way the concepts are used. It seems possible to streamline psychoanalytic theories by checking those therapeutic prescriptions which work against those that fail most of the time. Fascination for the theory itself may prove too strong, however, to make the proper assessment by those who apparently use it successfully.

Skinner believes that hypothetical entities said to exist inside the body must be validated by observations carried on inside the body and not by phenomena on another level. In other words, we cannot validate the "nerve trace," for example, simply by watching how people behave in everyday action. We must be able to check the presumed properties of the trace on the neurological level. Therefore, psychologists who know little about neurology are getting in deep water when they make naïve assumptions about the nervous systems and think that psychological observations outside the skin somehow prove the validity of the notions as neurological concepts. Psychologists have been embarrassed too many times by such practice to make it defensible. The logic of the transposed concept may be good, but good logic alone is not sound science. Unless the logical leaps can be anchored to observations, the handling of transposed notions must be considered a game that has only *potential* value. The potential should not be confused with empirical knowledge.

We must always seek the evidence that supports a given concept. And more importantly, we must be careful to note how tightly the evidence is bound to the concept. When the connection is loose and must be supported by debatable assumptions, then we should not use the concept by ignoring its degree of development. Many transposed ideas in psy-

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chology are not sufficiently developed to offer the kind of application that they may first seem to promise.

When one tries to take principles from one discipline and apply them to problems in another area, he should know something about the nature of the terms. It is not the psychologist's responsibility to give ready-made, neatly packaged tools to education. It is the responsibility of the educational psychologist to put the concepts into applicable form.

It is worthwhile to identify the bare bones of the principle and look at the kinds of properties that belong to its parts. *We define the principle as a statement of a relation said to hold generally between two or more key terms found in the discipline.* The simplest expression of a principle has three main parts, two key terms plus a relation term. The two key terms should have some functional relation; that is, when one changes the other ought to change in some systematic way. A good example in abbreviated form is our simple physics principle, which stated "pressure is equal to the total force divided by the area," or $P = \frac{F}{A}$

It is customary to refer to one of the key terms as the *independent variable.* In the teaching situation, an independent variable is usually something that influences the pupil's behavior. It can be one of many things such as praise, blame, an interesting book, gold stars, attention, affection, prizes, punishment, distracting noises, and others. When the teacher can manipulate strong independent variables, he can exert considerable influence on the pupil.

The second kind of key term in the principle is often called the *dependent variable,* that is, the thing which is being influenced. In the classroom the most frequent or common kind of dependent variable is the pupil's behavior. Any noticeable change in the learner's behavior that can be specified,

preferably measured, is valuable for both the teacher and researcher because it identifies the action of the pupil which is subject to change. Any behavior that can be systematically changed toward some goal we call *educable*. Some aspects of the person are educable and others seem much less so. Quite often the behavior which resists forces of education in the school are those habits which have already been strongly established. But even strong habits can yield to change under proper circumstances.

The third part of the principle is the relation term which indicates the kind of connection that exists between the independent and dependent variables. For example, "Operant behavior *increases* in frequency when reinforced" indicates the direction of change of behavior. The word *increases* points up the relation.

We shall now set up a simple paradigm of the principle so that it will be easy to study its features: I (independent variable)—R (relation)—D (dependent variable). We can condense it to: I—R—D.

What properties of the parts in the principle help to make its application easy? We could name eight or ten, but let us concentrate on a few that seem most important. We shall examine each element of the principle separately.

The independent variable should be manipulable, observable, and definite. When the influencer (independent variable) can be manipulated by either the teacher or pupil, then there is *control* available to the teacher or pupil to bring about a deliberate change in behavior. When neither the teacher nor the pupil can control the influencers, then behavior is controlled by caprice or is in the hands of people other than the teacher or pupil. We see that the degree to which caprice operates is the amount that systematic, deliberate education is limited. When psychology can help the

We can abbreviate further for convenience:

$$\underset{m,o,d}{I} \;-\; \underset{d}{R} \;-\; \underset{me,\,o}{D}$$

It should be clear that each of the above properties suggests its opposite; for example, manipulable suggests "nonmanipulable," "definite" suggests "vague," and so on. Let us list each property with its opposite.

measurable —nonmeasurable
observable —unobservable
definite —indefinite or vague
manipulable—nonmanipulable

To set up a paradigm that is easily managed we shall symbolize each property and its opposite as follows:

$\overline{m}$	m (called "m-bar")
$\overline{o}$	o (called "o-bar")
$\overline{d}$	d (called "d-bar")
$\overline{me}$	me (called "me-bar")

$\overline{m}$, $\overline{o}$, $\overline{d}$, and $\overline{me}$ stand for nonmanipulable, unobservable, indefinite, and nonmeasurable, respectively.

We can now inspect some principles and see how the suggested properties are relevant to application. Our first generalization or principle seems to have several negative properties and should therefore be difficult to apply directly. It is stated as follows:

Memory depends upon nerve traces.

$$\begin{array}{ccc} \vdots & \vdots & \vdots \\ D & R & I \\ o,d,me & \overline{d} & \overline{m},\overline{o},\overline{d} \end{array}$$

(Note that a principle can be written so that the dependent variable comes before *I*.)

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Memory is the dependent variable, and can be expressed in terms of such observable phonemena as responses to tests of recall. It is reasonably definite and can be measured. The relation term, however, is vague because it specifies no definite way in whicb D and I are connected. On the teacher's level of ohservation, nerve traces are nonmanipulahle, unohservable, and indefinite. We therefore helieve that considerahle processing must he done to make the principle applicahle. It may resist application by the teacher even after much effort to change the properties to more definite ones. The statement says: "Memory depends upon nerve traces." Under ordinary classroom conditions, the teacher cannot make any direct manipulation of nerve traces and even if he could hring them under control indirectly he would not be aware of just how much control that he was exerting. Also, the teacher does not know precisely what tbe term means even after he looks it up in a special dictionary. Since the teacher cannot have a good idea of how to begin to manipulate nerve traces, he is in no position to explain to the pupil how he may control them for his own henefit. All in all, the principle does not seem to be sufficiently developed for effective application by the teacher. Even if we took a specific teaching problem and made the context very clear, we still would bave difficulty trying to assign classroom events to the key terms. What events, for example, could we associate with "nerve trace"? Througb experimentation it would be possible to make the relation term more definite, but to do so would be the job of the pbysiological psychologist working under bighly controlled laboratory conditions. We conclude, therefore, that the principle is not applicable to the teaching situation.

The authors contend that many principles found in educational psychology texts have similar features even when the language seems more familiar than the terms in the one

under discussion. The kind of principles, treated in Chapter 2, called "static information" share several of the negative traits in the statement about nerve traces. For example, one given before should be sufficient to support our claim: "The effect of a teacher on a pupil depends in part on the background of both the teacher and pupil." We call such a statement "static information" because its properties serve to resist application.

A second illustration should be enough to show that principles can differ radically in features that are important for their application.

Reinforcers increase the frequency of associated operants.

I	R	D
m,o,d	d	o, me

The word *reinforcers* is the independent variable or that factor which influences some change in behavior. It has the properties "manipulable," "observable," and "definite." We ought to point out that, although it is not definite as it stands, "reinforcers" can easily be assigned very definite referents. We see that a principle is only a verbal statement which provides the possibility of assigning actual events, in the problem, to the key terms. The general rule of the applicability of a principle can be stated as follows: *It should be convenient to assign classroom events central to the problem to key terms in the principle.* A good principle must not only have the positive properties indicated above, but it must lend its key terms as class names for the kinds of events that exist in the teacher's problem. There are many good principles of physics and chemistry that have the features in our paradigm, but their key terms cannot be used to classify things that exist in classroom problems of learning. To the term "rein-

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forcers" we can assign many manipulable classroom events, for example, praise, tokens, attention, affection, awards, high grades, encouragement, special privileges, and others.

The word *increase* in the principle above is fairly definite. It indicates the direction of influence by conveying the meaning that when reinforcers are presented the operants which led to them will be strengthened, that is, they will become more likely to occur.

Associated operants is a useful term because any voluntary act can be assigned to it. Many such acts are observable and can be measured in terms of frequency of occurrence.

The student should find it interesting to take a number of principles at random from educational texts and apply the above analysis.

We should mention the reminder again, however, that the proper beginning for applying psychological principles to teaching lies in the teaching or learning problem. There may be many problems that do not call for the kind of psychological concepts that exist in our chosen psychology. But whatever psychology is used, we think that it is possible to analyze principles to estimate just how readily they can be applied to a given problem. We do not say that principles which lack the features we have indicated are not applicable theoretically. But we do say that before a given principle is ready for use it should be processed so that it takes on the features we have named. Usually, the required processing calls for laboratory experiments that can promote the development of principles. We have reference to experimental definitions, the kind of definition in which the referents can be identified in some functional relationship. Therefore, when principles lack the qualities noted, we think that they suggest a state of underdevelopment. Attempts to use such

principles in teaching should begin with recognition of their developmental stage.

Classroom Research to Test Operating Rules. We have not yet described how the teacher can carry out reasonably good research without being a scholar of research methods. We believe that educational research has the same general characteristics as research in the natural sciences. Pupils can easily carry out plausible experiments in physics, chemistry, and biology without seriously violating any canons of good investigation. We think that a counterpart of simplified, but highly useful, research can be done in the classroom. We further believe that many of the complex studies which have complicated designs and employ intricate statistical tests have not yielded much value to teaching. One trouble with the traditional designs, which tend to confuse the average teacher, is that they leave too much to conjecture. Typically, some pretest is given, followed by an experimental teaching method, which is followed by a posttest. Results are compared with a "control" group which has not had the experimental treatment. Another difficulty of such experiments is that too much importance is put on the statistical results. A specific weakness of such stress is that little or nothing is known about the instrumental behavior of the individual by looking at the results. Good teaching is a *growth* process. We are interested in making records of changes *as they occur* during the learning session. A blob of numbers at the end of a study that suggests how much pupils have learned is largely beside the point.

The Single-Pupil Experiment. Research begins with a problem. Graduate students doing research in college often find it hard to locate problems. But the teacher should have no such difficulty. Problems continually arise in the teaching

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situation. Most of them have to do with individuals. Johnny does not participate. Fred does not seem to understand division. Sally never completes assignments. Mary likes to do many "irrelevant" things. One or more problems can be found in the behavior of every pupil, especially when we are oriented to improve the efficiency of learning. Problems should arise naturally within the classroom.

We begin with the single-pupil experiment because it is often the easiest to do and is perhaps the most important kind of study that teachers can do. It can be free from complicated data that call for involved statistical treatment. And it can be carried on without elaborate changes of normal conditions. In fact, no one but the teacher need know that an experiment is occurring.

What are the steps in the single-pupil experiment? They are outlined as follows:

Careful Statement of the Problem. When the problem is clearly stated, about half the battle is over. A good, lucid problem that is kept simple implies the procedure necessary to solve it. Problems can be put in question form or stated as declarative sentences. A few examples in question form should make the point clear:

> Can successive approximations be applied to increase Johnny's participation?
>
> Will Fred grasp division if put on a teaching machine with a division program?
>
> Can verbal praise for completing simple tasks help Sally get in the habit of completing other tasks by using the successive approximations technique?

What are the important elements of a researchable problem? They are the same elements found in the applicable principle. Notice that the above questions contain an inde-

pendent variable (I), a relation term (R), and a dependent variable (D). Therefore, the I—R—D paradigm can be used as a guide. Remember, the main thing is to state the problem so that the independent variable is observable, manipulable, and definite. The relation term should be definite while the dependent variable (the behavior to be changed) is both measurable (frequencies of an act can be counted) and, of course, observable.

Identification and Control of Variables. Perhaps what is most difficult for the teacher is to acquire skill in manipulating the independent variables. Skillful reinforcement is to some extent an art which can be improved with practice. If the teacher is "reinforcement oriented," he should gradually acquire sufficient skill to manipulate a large number of reinforcers effectively.

One of the most challenging tasks is to locate the special reinforcers that have a unique effect on some pupils but not on others. The teacher ought to spend time building a "reinforcement profile" for those pupils who present the most problems. The teacher does not have to give a complicated set of psychological tests to find out the things that interest the pupil. It is probably better not to use the tests. Interest tests are often deceiving because they include items that the pupil is unprepared to assess; that is, he may have had no experience with some of the cited things that will allow him to make a realistic preference. Interest tests may be good research tools for the professional researcher, but they probably have little significance for the teacher doing classroom studies.

The problem of locating the things that will influence a given student is largely met by seeking reinforcers that move him. Each child has some unique proclivities. We do not know that even praise from the teacher will be a positive

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reinforcer for Johnny until it is tried. If it does not work, then something else must be sought. Quite often when praise from the teacher is avoided by the pupil, he may be under peer pressure to resist the teacher instead of cooperating with him. Consequently, the effective reinforcers may be located somewhere in the group. The teacher should try to find which pupils can get Johnny to do things willingly. Study the interactions to see what reinforcers may be operating. Once they are found, forms of indirect control can be used; that is, other pupils can be *stimulated* to *reinforce Johnny* for doing certain things in accord with learning goals.

A cumulative record of observations should include those behavior patterns that are strong. Locating such patterns puts the teacher in a good position to find the associated reinforcers. The teacher must be prepared to find reinforcers which are not approved, such as cigarettes, knives, and the like. Such things suggest the strength of influence of an outside reinforcing system. As noted in an earlier chapter, when the reinforcement and punishment system of the community functions to strengthen behavior incompatible with the aims of the school, then the teacher has problems that may not be solvable because he lacks the kind of control necessary to compete with the "hostile" environment. Slum areas usually provide the most incompatible systems of reinforcement. The teacher is unlikely to be successful in competing with such forces. Ideally, the solution to such a problem lies in community redesign which calls for active cooperation of all the social agencies in the community.

When the reinforcement and punishment system of the community harmonizes with the efforts of the school, then the teacher can manipulate the reinforcers effectively. (Reinforcement systems found in the home are included in the phrase "community reinforcement systems.")

Getting and Tabulating Data. In the one-pupil experiment, the teacher *must* not only define the problem, locate effective reinforcers, and apply them, but he must also keep some record of the experimental operations and results. The teacher ought to keep a cumulative record of the kind and number of reinforcers applied along with observable changes in pupil behavior. A single sheet of paper may often suffice. A record similar to the following should be effective.

Name: Bill Beaver
Task: Verbal praise to increase the frequency of voluntary recitations.
Number of reinforcers: //////////
Number of recitations: ////////////

Simple frequency counts, as indicated above, should suffice. It would be better, however, to have a record of the days reinforcements were applied and dates of observable voluntary acts along with some description of the conditions in which such acts were emitted. The teacher should preface his experiment by establishing a base line, which, in the case of the experiment with Bill Beaver, is the frequency of voluntary recitations *before the experiment.* It may take a week or two to establish base lines for some kinds of behavior. The change in responding during the experiment can be compared to the base line data. Any worthwhile result will be dramatically reflected in the frequency counts. There is no need for statistical analysis.

If the results do not accord with expectations or no changes occur at all, then some shift in the technique of giving reinforcement or in the kind of reinforcers should be considered and adopted.

The Group Experiment. The single-pupil study should be the backbone of classroom research because it fits in nicely

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with everyday teaching. It should be considered a part of good instruction. There are frequent occasions, however, when the teacher will want to apply a change that will impinge upon the whole class. The suggestions given in the analysis of teaching media can be used for beginning group experiments. The steps can be outlined as follows.

Careful Statement of the Problem. We follow the same procedure as before by taking those problems that exist in the normal course of affairs in teaching. Group problems, however, usually center on the effectiveness of procedures experienced by all pupils. The teacher may note that some practice has not worked very well. This is the cue for recognizing a problem, for clarifying it, and for seeking promising operating rules. When the teacher becomes familiar with a psychology that is rich in usable tools, then he should be able to make his own operating rules. Examples given in the foregoing chapters should suggest the kind of thinking that is done to develop testable notions. It is probably wise to stick to the "I—R—D" paradigm for setting up simple operating rules, which should be put in the form that will allow them to be analyzed for presence and absence of desirable properties.

Identification and Control of Variables. The best place to look for manipulable variables is right in the teaching methods. When the teacher finds that a technique has not worked effectively, he should analyze the method by looking for the variables. He should go into detail in trying to describe just how the method has been put into practice. He should be especially aware of the unique properties because they suggest what teaching functions are most characteristic of the method. He should then proceed to ask: How have I been managing the unique factors of the medium? What have I been expecting the medium to do? Could it be better

used to promote some other phase of learning? Also, he should inspect the sequence of media as they have been applied. Are lectures given *before* reading assignments on the topics? If so, what would happen if the sequence were reversed?

It is important to be very clear about the behavioral changes which are desired. We cannot overstress the making of a detailed blueprint of a course. The objectives should be broken down to specific performances and tasks so that some intelligent choice can be made of the media that best promise to stimulate success. Unless the teacher knows just what things he is supposed to help the pupil learn, he is not in the best position either to bring about such learning or to measure it to assess achievement. So the definition of a clear-cut problem should center on the disparity between the projected aims and actual learning. It seems imperative to know just what special performances must be acquired to judge whether or not a pupil has succeeded. The teacher should learn how to blueprint a course as suggested by Travers in his valuable book *How to Make Achievement Tests.*

Getting and Tabulating Data. When dealing with groups, achievements tests seem to be the most convenient instruments for collecting data. Instead, however, of using tests only as pre and post measures, we suggest the following plan:

> Begin with a pretest over the entire unit or topic. Results will show how much the pupils already know about the topic.
>
> Next, break down the topic into smaller units. Apply the experimental teaching method long enough to cover the topic.
>
> Instead of using the achievement test only at the end of the topic, give several short quizzes perhaps every day until the topic is covered. The short quizzes will contain the same or parallel items as the large pretest.

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Keep a record of the amount learned on each quiz. We see that the daily quizzes serve as a kind of cumulative record.

Combine the quiz scores into one large score for each pupil and compare the combined score with the pretest score. The difference suggests how much has been learned.

Later on, test for retention by giving the entire test again at one sitting.

The results will show how much learning has taken place, and the quizzes will help the teacher to assess the effectiveness of the daily experiences. Thus, efficiency of acquisition can be estimated. The large or combined posttest for retention will provide an estimate of how effective the maintenance experiences have been. It is probably best to measure immediate learning and retention separately instead of trying to assess the whole teaching method by only one test. If only a retention test is given and results are poor, that does not mean that learning has not taken place. It may mean either that little or no initial learning has occurred or that acquisition may have been good but was forgotten. The teacher should have data on both immediate learning and retention because results will suggest whether changes ought to be only in the maintenance experiences or in both acquisition and maintenance efforts.

The teacher should probably have help in carrying out group experiments because of the problems of control, measurement, and interpretation. But it is not necessary to have complicated statistics to measure the significance of gains, unless the gains are *obviously* large; then one of two things has gone wrong: the objectives were already pretty well achieved *before* the learning experience or the teaching media have been used ineffectively. It is probably better to analyze the results on an individual basis than by groups, be-

cause some pupils may have gained greatly while others may have even lost ground. A study of large and small gains may suggest how to group pupils to offset the negative or small gains. The teacher should not let the individual get lost in statistical averages, because if only a few pupils are not achieving the goals then some changes ought to be made. Paying attention only to averages may foster a kind of rigidity about teaching that should never occur. While it is worthwhile to note how well the class has achieved as a group, the stress should be on individual changes.

The foregoing should make fairly clear the nature of classroom research that can become an integral part of teaching. We should keep in mind that the teacher has many means at his disposal to bring about changes in behavior. He can control various media. The large problem is to determine how the media can be combined to produce the most efficient results. It is probably a waste of time to compare one method against another, as found in the traditional methods experiments.

Another kind of assessment that is worthwhile is to find the "stimulus value" of the teacher on the pupil. We say that the teacher can be thought of as a complex of stimuli that bear upon the pupil. A teacher may be a strong source of positive reinforcement for one child while representing an equally negative force to another child. The teacher can estimate his stimulus value by noting what a pupil does voluntarily. If the pupil tends to approach the teacher often for advice and help without signs of fear, then the teacher is probably a strong positive stimulus for that pupil. When a teacher finds that a child regards him as an aversive stimulus, the problem is to discover why. The teacher must be candid in admitting his own feelings for the child. If he dislikes the way the child dresses and acts and tends to give him more

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negative feedback than other pupils, the trouble may lie there. It is sometimes difficult for the teacher to show genuine appreciation for a child who reflects habit patterns that the teacher has learned to scorn. The friendly, outgoing teacher has a great advantage over the unfriendly teacher, especially with young pupils, because he can use positive reinforcers more effectively. But during maturation in learning, the child must be gradually taught frustration tolerance so that when he gets older he is not so disturbed by teachers he does not particularly like. The college student who goes out of his way to avoid an instructor that is demanding and not particularly friendly has not matured sufficiently to get the most of his college training. The many problems involved in shaping frustration tolerance are difficult and challenging. But they can probably yield to the same kind of analysis we have been using. The next topic touches the problem in more detail.

Reinforcement and Social Maturation. Modern reinforcement psychology is rapidly expanding its scope of influence. An important feature of reinforcement, as developed by Skinner, is its pervasive significance. It is valuable in describing learning in simple organisms as well as in humans. Let us extend the notion further by examining reinforcement as a descriptive tool in dealing with social maturation.

Reinforcers, whether positive or negative, are those events associated with strengthening certain classes of behavior. Presentation of an aversive stimulus, for example, strengthens either aggression or withdrawal. Presentation of positive reinforcers strengthens the instrumental acts which just precede the reinforcers. Primary reinforcers such as food and drink are instrinsic in the sense that the genesis of their power to influence behavior is independent of association with other reinforcers. Secondary reinforcers, however, acquire their power to influence behavior by being paired with

primary ones. Skinner calls the latter "conditioned reinforcers."

Consider the acts in the repertory of a single individual. Many of his acts deal with reinforcers. We can conveniently divide behavior into two large classes: acts that *consume* reinforcers, and acts that *produce* them.

Consumption of Reinforcers. Perhaps all overt behavior modifies the environment to some extent. When something in the environment is changed by an act, the environment often *reacts*. The reaction is the consequence of an operant. Reinforcement psychology holds that experienced consequences function to change the strength of instrumental acts. In other words, patterns of behavior are established by the effects of experienced consequences. We can diagram the meaning of consumption:

Paradigm	initial act	—	change in E	—	reinforcer provided by E agent	— reinforcer consumed
Example	infant cries	—	cry alerts mother	—	mother provides food	— infant drinks milk

The symbol "E" stands for "environment."

The important aspect is that the initial act is the stimulus that sets something in the environment in motion to provide the reinforcer. The consumer expresses a desire which is fulfilled by someone else. If the signal of desire is obeyed, no further effort is rquired by the consumer toward acquiring the reinforcers. If the signal is not obeyed, then the organism shows frustration.

Production of Reinforcers. The following paradigm points up the meaning.

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Initial act (operant)	stimulates self to provide reinforcer	acts of production	product	dispensation of the product

The initial act stimulates the organism toward self-production. The final product may be consumed by the producer, consumed partially, shared with others, or given entirely to others. If the product is shared or given to others to consume, we say that either the sharing is reinforcing or the act of production is reinforcing, or both, provided no coercion is involved.

In the early agrarian society of America and up until recently, children were valuable producers on farms. They learned the contingencies of reinforcement of productive behavior. Hence, they could assess their own value to the family rather clearly. Today the picture has changed. Children are primarily consumers for as long as they remain with their parents. It is quite possible that the great difference in productive behavior typical of the agrarian society and modern urban society has had a profound effect on the youth of America. Let us examine some possible psychological reasons why.

Pure consumption behavior tends to satiate primary drives quickly. Behavior that produces reinforcers is not so limited by success because the limit of such behavior is relatively independent of homeostasis. Perhaps the main physiological limitation of productive behavior is fatigue. The child can learn to value productivity by the social contingencies that impinge upon him. If he is taught how to produce something valuable to others, then success is reinforced. He associates the acts of production with social approval. If he is denied the opportunity and encouragement to produce something valuable to others, his behavior will be primarily in pursuit

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n *function of the difference between production of positive reinforcers ond consumption of reinforcers.* We can state it more succinctly as: $SM = f(P - C)$, where "SM" is social maturation, "P" is productive behavior, and "C" is consumption. A more complete function should include the production of *negative* reinforcers or those events that are aversive. Our equation now becomes: $SM = f[P - (C + \bar{P})]$, where $\bar{P}$ is the production of negative reinforcers.

The rationale for the principle can be pointed up by a hypothetical illustration. If we manage the nurture of a human so that immediate and ample reinforcers are supplied to him upon signals of desire, and if we carefully deprive him of opportunities to produce reinforcers, he would have only an idinal development. He would be socially maladjusted because he has not learned how to reinforce others. When one obeys rules of society, he must keep the production of aversive stimuli under control. By so doing, be is able to avoid that amount of negative feedback which would have resulted as reaction to his aversive behavior. As the amount of aversive stimulation increases in social interaction, both aggression and withdrawal increase. Production of positive reinforcers is curtailed. As the amount of mutual reinforcement decreases among members of a group, the greater the amount of coercion is needed to sustain existence of the group.

A person who has not learned how to reinforce others is likely to expect them to act as servants to him or as potential enemies. If his past schedule of reinforcement is nearly continuous he will tend to treat others as servants to his whims. If his history shows great deprivation, he is likely to fear others, that is, when he has learned to expect a minimum of reinforcement and much aversive treatment.

A well-nurtured infant is reinforced almost continuously.

He is usually reinforced for nearly every signal he emits that is interpreted as something he needs. As he develops, there is usually a gradual decrease in continuous reinforcement which is replaced hy intermittent schedules. There are two effects of intermittent reinforcement: frustration tolerance increases, and the individual hecomes more likely to engage in sustained aetion which is only occasionally reinforced. Hence, intermittent schedules are likely to increase the probability of productive behavior.

Rude behavior is simply socially aversive action. The reaction to aversive stimuli is either aggression or withdrawal. A youth who has not learned the art of producing reinforcers for his peers is treated either as an aversive stimulus or ignored as "ineffeetive."

Aggression is strengthened when reinforced. It is not necessarily extinguished merely hy letting it be expressed. A good illustration is given hy the way Jews were treated in Nazi Germany. Since aggressive acts against Jews were reinforced, intensity of them grew to a high pitch. Catharsis tends to extinguish aggressive verhal expressions because they are not reinforeed.

While physiological factors can influence maturation, our speculation maintains that a large portion of delay in maturation is a function of deprivation of reinforcers and their mismanagement. One form of mismanagement is inconsistency in the reinforcement schedule; it is the mixing of positive and negative feedback for the same act. One implication is that the quickest way to break the psychological integrity of a person would be to put him under conditions wbere strong positive reinforcers and strong punishers were randomly presented. It would be impossible for him to establish any consistent pattern of action that would allow him to acquire the positive feedback and avoid the punishers. Therefore,

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an important feature of successful adjustment is some fairly consistent reaction from the environment. Since the social aspects of environment (people) are more variable than most inanimate things, it is little wonder that maladjustment is usually social in form.

Some testable hypotheses.

a. The success of rehabilitation programs for delinquents is partly a function of the availability of opportunities to learn how to produce reinforcers valued by society.

b. When a student regards a course as valuable for reaching a desired end and his success in learning the subject matter is low, frustration will produce noticeably high manifest anxiety.

c. The reasons given by a pupil for wanting to succeed in specific pursuits can be arranged to form an index to social maturation. Data would be sorted in the categories of: consumption of primary reinforcers, consumption of conditioned reinforcers, production of positive reinforcers, and production of negative ones. Data could be cross-checked by observations which would be guided by a schedule developed on the basis of the above categories.

d. Pupils who are low in social maturation will show a greater amount of underachievement than those who are high in social maturation.

e. When the frustration tolerance of a teacher is low, the amount of aggression exhibited by pupils in a free situation will be higher than pupils used to a teacher having high tolerance. It would be possible to assess frustration tolerance of the teacher by the kinds of frequency of pupil acts that the teacher punishes. Another measure of frustration tolerance could be taken by the number of punishable acts a teacher checks in a list.

The above sample of hypotheses is not the most fruitful

of all samples that could be drawn from our treatment on social maturation. It serves, however, to suggest how a particular viewpoint on reinforcement can stimulate testable predictions beyond the usual scope of the concept. The most valuable inquiries would be attempts to determine which controlled operations in the school influence social maturation.

In this book we have tried to put the stress on teaching because we wished to spotlight the teacher. Most books on educational psychology seem to emphasize learning. Instruction is teacher-centered, while learning is pupil-centered. But the two cannot be neatly separated. The full concept must be "teaching-learning," which implies an interaction between the teaching media and the learner. We have focused mainly on the teacher because he is the one who is supposed to initiate the strategy of instruction and is therefore the one who must be prepared to use the psychological tools toward solving the problems of diagnosis and prescription to improve the learning situation. We believe that the teacher must be put back in the classroom as an important manager and catalyst of learning. We have also tried to make psychology *educational* and not simply something that the teacher learns from books and lectures without taking the final step of putting the knowledge to work.

If our efforts have done nothing more than serve as a strong reminder to educational psychologists that they are responsible for developing workable techniques of application, rather than expecting the academic psychologists to provide polished tools ready for use, our work will have been rewarding. We urge those better qualified than we to improve upon the beginning which we have tried to outline.

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